BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
WESTERN ZONE BENCH, PUNE
AT PUNE

ORIGINAL APPLICATION No.220 of 2023

In re: News item appearing in The Indian Express dated 30.11.2023 titled "Fire at chemical plant in Surat, 24 workers injured"

PRELIMINARY REPLY ON BEHALF OF RESPONDENT No.4 (AETHER INDUSTRIES LIMITED)

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PUNE

DATE :04 /07 /2024



ADVOCATE FOR THE APPLICANT

1951

IN-GJ21557196914561W

INDIA NON JUDICIAL

Government of Gujarat

Certificate of Stamp Duty

सत्यमेव जयते

Sr.No. 1951 of 2024
Date 4/7/2024

Certificate No.	:	IN-GJ21557196914561W
Certificate Issued Date	:	04-Jul-2024 04:08 PM
Account Reference	:	IMPACC (SV)/ gj13105904/ SURAT/ GJ-SU
Unique Doc. Reference	:	SUBIN-GJGJ13105904612292164147O7W
Purchased by	:	AETHER INDUSTRIES LIMITED
Description of Document	:	Article 4 Affidavit
Description	:	AFFIDAVIT
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	AETHER INDUSTRIES LIMITED
Second Party	:	National Green Tribunal Western Zone
Stamp Duty Paid By	:	AETHER INDUSTRIES LIMITED
Stamp Duty Amount(Rs.)	:	300 (Three Hundred only)

NOTARY NARENDRA M. SURATI 1951 SURAT DIST. REG.NO. 7180 GOVT. OF INDIA

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NOTARY NARENDRA M. SURATI 1978 SURAT DIST. REG.NO. 7180 GOVT. OF INDIA

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

WESTERN ZONE BENCH PUNE

AT PUNE

ORIGINAL APPLICATION NO. 220 OF 2023 (WZ)

In the matter of news item appeared in the newspaper 'Indian Express' dated 30.11.2023, titled as '**fire at Chemical Plant in Surat, 24 workers injured.**'

AFFIDAVIT IN COMPLIANCE IN RESPECT OF ORDER DATED 22.05.2024 ON BEHALF OF RESPONDENT No.4 (AETHER INDUSTRIES LIMITED)

I, Smit Manishbhai Desai, adult, occupation: service, having office at Plot No: 8203, Sachin GIDC, Sachin - 394230, Tal: Chorasi, Dist: Surat, do hereby state on solemn affirmation as under: -

1. I say that I am working with Respondent No.4 in the capacity of Senior Engineer (Process Safety) and am aware of the facts and circumstances of the present case and authorised to depose the same on oath. I say that the Respondent No.4 is filing without prejudice the affidavit in compliance to the order dated 22nd May 2024 passed by this Hon'ble Tribunal and reserves its right to subsequently file a detailed response.
2. I say that the incident of 30th November 2023 was a very unfortunate one despite all due diligence and precautions. The Respondent No.4 undertakes that in future too it would continue to take all steps and due care to ensure that the same is not repeated.
3. I say that the Respondent No.4 has already filed a preliminary reply on 8th January 2024. I hereby adopt, affirm and reiterate the contents of the said reply as part and parcel of the present affidavit to avoid repetition. At the outset, the Respondent No.4 submits that, the fateful incident that occurred on 29.11.2023 is most unfortunate and the Respondent No.4 deeply sympathizes with the families of the all-deceased persons. However, the Respondent No.4 would like to state on record that, the

For Aether Industries Limited

Auth. Signatory / Director

Respondent No.4 has been scrupulously following and complying with all the statutory compliances and also by obtaining the necessary legal permissions to run the Company.



4. It is humbly submitted that the Respondent No.4 has taken utmost precaution at the time of its process and that it was on account of a error beyond control, which occurred on the said date, which led to the fateful incident.

5. I say that the Respondent No.4 has been carrying out the HAZOP studies on periodical basis. In compliance to the directions of the Hon'ble Tribunal, the same are produced herewith for the perusal of the Hon'ble Tribunal. Copies of the HAZOP studies are annexed hereto and marked as **ANNEXURE – R-1 colly**.

6. I say that the Hon'ble Tribunal has also directed the Respondent No.4 to place on record the turnover for the last 3 financial years. The same are also being produced herewith for the perusal of the Hon'ble Tribunal. Copies of the turnover documents are annexed hereto and marked as **ANNEXURE – R-2 colly**.

7. The Respondent No.4 further submits that on account of the said fateful incident, the Respondent No.4 has taken effective steps as was possible for the Respondent No.4 in accordance with the law. The Respondent No.4 was permitted to operate its manufacturing operations, but not at the full capacity, but allowed to operate at 25% manufacturing capacity.

For Aether Industries Limited

Auth. Signatory / Director

The Respondent No.4, thereafter received letters dated 8th April 2024 and 13th May 2024 from the Respondent No.3 permitting it to start the operations. In accordance to the letters of the Respondent No.3, the Respondent No.4 is maintaining the pipeline as suggested and directed. Copies of the said letters along with its translation are annexed hereto and marked as **ANNEXURE – R-3 colly**.

8. The Respondent No.4, in view of the aforesaid letters, forwarded it to the Respondent No.2 and requested it to operate the unit at full capacity. The Respondent No.2 vide its letter dated 18th May 2024, directed the Respondent No.4 to operate at 75% of its capacity. Copy of the letter dated 18th May 2024 is annexed hereto and marked as **ANNEXURE – R-4**.

9. The Respondent No.4 submits that, it *has ensured* that no such untoward incident takes place in the future and as *per advise of the technical experts and directions of the authorities* has installed best safety equipment's, so as to control damage, if any accident such takes place. The present incident which *led* to the mishap, was on account of fire due to *circumstances* beyond its control. The Respondent No.4 further *assures* that it will abide by all the legal provisions and that the authorities may be directed to issue requisite permissions in order to enable the Respondent No.4 to commence the manufacturing at full capacity. It is therefore *submitted* that the application may kindly be disposed of in view of the submissions made by the Respondent No.4 as stated above.

10. In view of the material *submitted* by this Respondent Nos. 2 and 3 before this Hon'ble Tribunal, it is abundantly clear that, the

For Aether Industries Limited

Auth. Signatory / Director

Respondent No.4 has taken effective steps to minimise environmental damage occurred on account of said fateful incident on 29.11.2023. Thus, nothing survives in the present Original Application and the same may kindly be disposed of.

11. I say that whatever stated in the present Affidavit is true and correct to the best of my knowledge, information and belief and the legal advice, which I believe to be true.

Solemnly affirmed at _____, on ___ day of July, 2024.

NOTARY NARENDRA M. SURATI SURAT DIST. REG.NO. 7180 GOVT. OF INDIA

NOTARY NARENDRA M. SURATI SURAT DIST. REG.NO. 7180 GOVT. OF INDIA

Identified by me



For Aether Industries Limited

Auth. Signatory / Director

Deponent

ATTESTED & IDENTIFIED

NARENDRA M. SURATI
NOTARY
SURAT
GOVT. OF INDIA
Regd.Sr.No.: 19701
Date: 4/7/24

NARENDRA M. SURATI
ADVOCATE & NOTARY
101, Shree Darshan Society,
Opp.L.D. School, Near Shreeji
Row-House, Station Road,
Sachin, SURAT-394230
Mo.: 98980 11199

NOTARY NARENDRA M. SURATI SURAT DIST. REG.NO. 7180 GOVT. OF INDIA

ANNEXURE - R-1 colly

HAZOP STUDY REPORT OF

EO STORAGE TANKS

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

OCTOBER 2016

aether
elementally innovative



NEXA
Process Safety Engineers

AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

HAZOP STUDY REPORT OF

EO STORAGE TANKS

OCTOBER 2016

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.



Surat **Proprietor**

06/10/2016 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for EO Storage Tanks.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for EO Storage Tanks. It has 1 node as per following:

NODE NO.	NODE DESCRIPTION
1.	EO Storage Tanks (110ST-001& 110ST-002)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study

leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

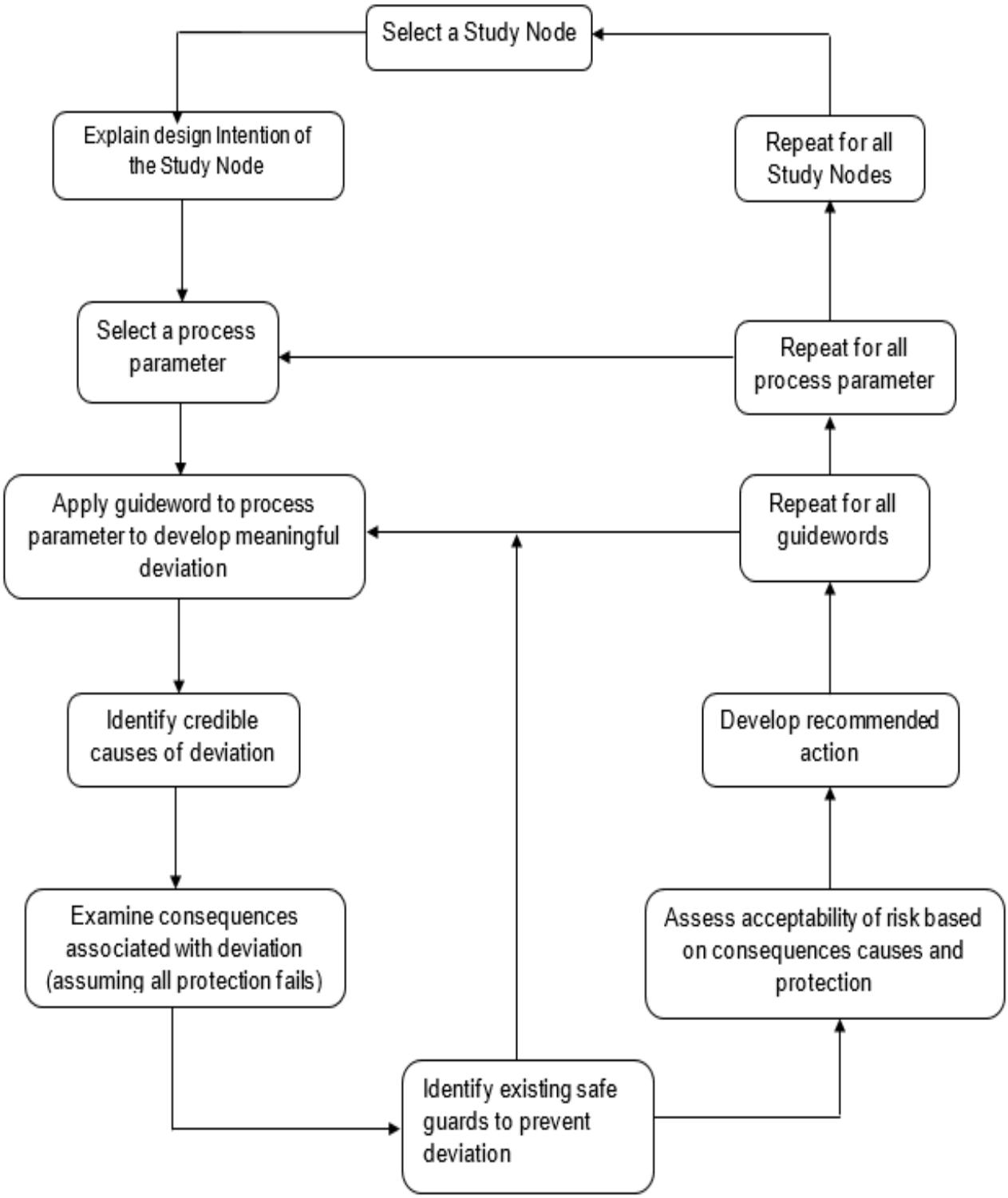
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	110ST-001& 110ST-002

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

"...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	EO Storage Tanks (110ST-001& 110ST-002)	EO Storage Tanks (110ST-001& 110ST-002)	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	Instrument

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please

refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTE

HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									**Plant Name: 8203 Date- 05-10-2016**			
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Node 1		**Node Description: EO Storage Tanks (110ST-001& 110ST-002)**										
1	Quantity/Flow	No/Less	Not Applicable									
		High/More	Not Applicable									
		Reverse	Not Applicable									
		Mis-directed flow	Not Applicable									
2	Pressure	Low	line leakage/Flange leakage/Tank Leakage	Fire & Explosion hazard	1. EO detectors are available to detect leakages with high and high alarms on DCS. 2. PT is available to monitor pressure in the tank with alarms. 3. Pressure test is being carried out before starting batch. 4. 300 class flanges are used. 5. Sprinkler system is provided in the tankfarm. 6. Fire hydrant points are available. 7. All electrical	3	3	9	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	2	3	6

HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									**Plant Name: 8203 Date- 05-10-2016**			
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					installations in the tank farm are as per HAC classification. 8. Tank pressure testing is performed as per PM schedule.							
		High	N2 line manual valve pass	Tank may pressurise	1. EO storage tank design pressure is 6 bar. 2. PT is available in the tanks with HH alarms and flash alarms. 3. 1 number of RD & PSV in series and 1 separate PSV is available to prevent over pressurisation in the tank which is connected to water catch pot 4. Sprinkler system is provided in the tank farm. 5. Fire hydrant points are available. 6. All electrical installations in the H2 yard are as per HAC classification. 7. N2 PRV (1.5 bar) is available to reduce over pressurisation due to nitrogen pressure.	3	3	9				

HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									**Plant Name: 8203 Date- 05-10-2016**			
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vent line valve closed while filling material		1. CV is available in the charging line and interlock is available to close CV at HH pressure of tank.	3	3	9				
			Loss of cooling in jacket		1. Brine supply is provided in the jacket with TI and alarms and flash alarms. 2. Interlock is available to open brine supply line ROV at HH temperature of tank.	2	3	6				
3	Temperature	Low	No HSE Hazard									
		High	Loss of cooling in jacket	Temperature & pressure rise may possible in the tank	1. TT is available in the tanks with HH alarms and flash alarms. 2. 1 number of RD & PSV in series and 1 separate PSV is available to prevent over pressurisation in the tank which is connected to water catch pot 3. Sprinkler system is provided in the tank farm. 4. Fire hydrant points are available. 5. All electrical	3	3	9				

HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									**Plant Name: 8203 Date- 05-10-2016**			
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					installations in the H2 yard are as per HAC classification. 6. Interlock is available to close discharge line CV and incoming line CV at HH temperature of the tank. 7. ROV is also available in the brine supply line.							
4	Level	Low	Tank leakage	Fire & Explosion hazard	1. EO detectors are available to detect leakages with high and high alarms on DCS. 2. PT is available to monitor pressure in the tank with alarms. 3. Pressure test is being carried out before starting batch. 4. 300 class flanges are used. 5. Sprinkler system is provided in the tank farm. 6. Fire hydrant points are available. 7. All electrical installations in the tank farm are as per HAC classification. 8. Tank pressure testing	3	3	9	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	2	3	6

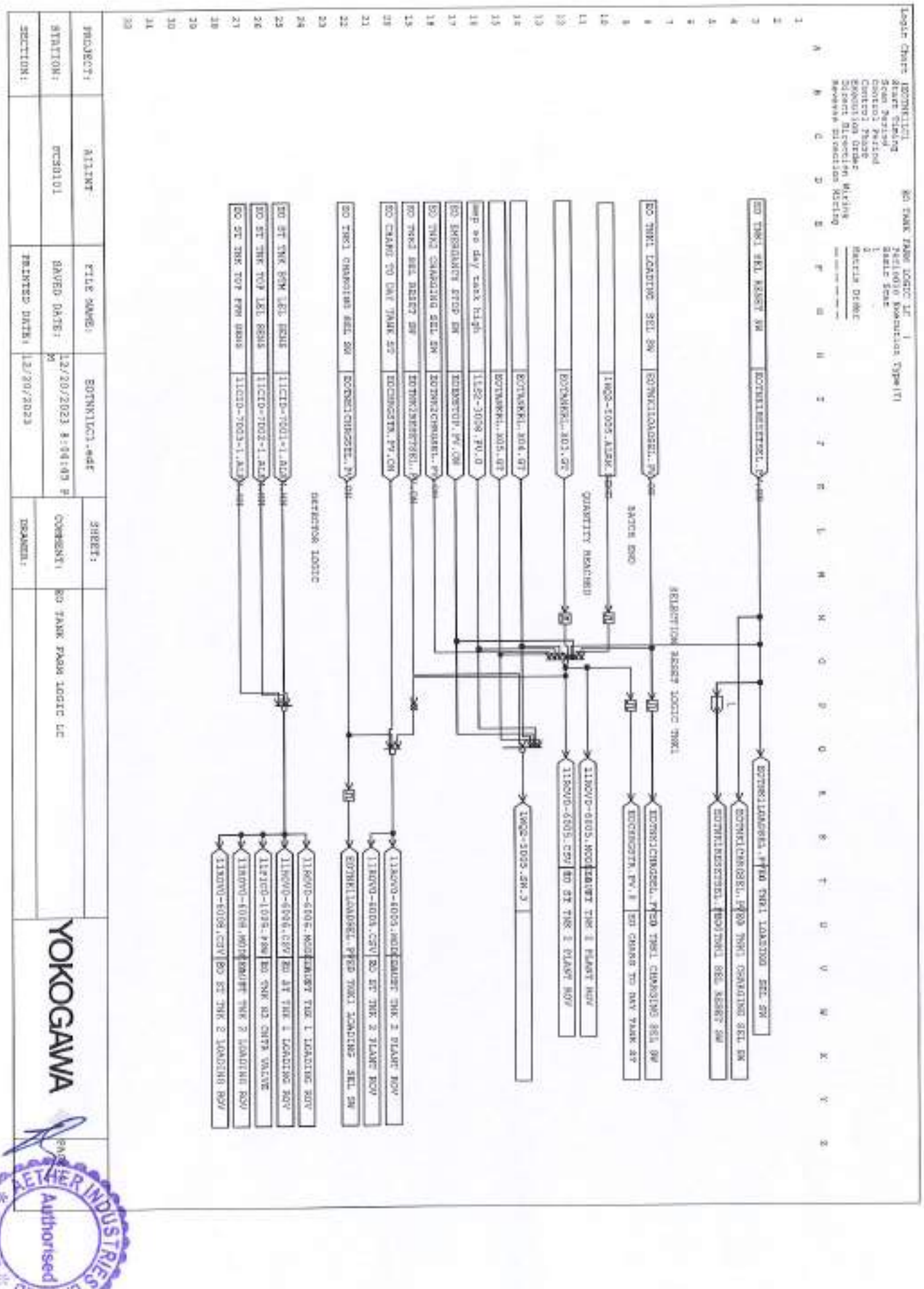
HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									**Plant Name: 8203 Date- 05-10-2016**			
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					is performed as per PM schedule. 9. LI is available in the tank to monitor the level with alarms and flash alarms.							
		High	More material filled (Human Error)		1. Interlock is available to close incoming line CV and ROV at HH value of LI. 2. Flash alarm is also available on LI HH alarms. 3. Trained manpower will operate and verification of level is performed before filling material.	3	4	12				
5	Others	Static charge	-	Fire & Explosion hazard	1. Earthing jumpers are provided in lines. 2. Double earthing is provided to the tank. 3. Earth rite system with hooter is provided to maintain earthing continuity while filling EO. 3. Earthing continuity testing is performed before start-up. 4. Nitrogen padding is performed in the both the	3	4	12				

HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									**Plant Name: 8203 Date- 05-10-2016**			
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					tanks to eliminate air ingress in the tank.							
		Instrument Air Failure	Air compressor failure	Tank may pressurise	All instruments air fail safe position is air fail to close and brine supply line ROV is air fail to open.	4	1	4				
		Power failure	GEB power failure	Tank may pressurise	DG backup provision is available.	2	2	4				
		DCS Failure	Battery bank failure	Tank may pressurise	Redundant battery bank is available & PM is performed as per schedule.	2	2	4				
		Agitation	Not Applicable									

---- END OF THE REPORT -----

HAZOP -EO storage tanks						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	EO Storage Tanks (110ST-001& 110ST-002)	EO Storage Tanks (110ST-001& 110ST-002)	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	Instrument	Completed	1




Logic Chart: BDTNKLIC1
BD TANK FARM LOGIC LC
Attach Dialog
Scan Rating
Control Period
Control Mode
Execution Order
Direct Direction Mixing
Reverse Direction Mixing
Period(s) Execution Type(T)
Basic Scan
Basic Disc
BDTNK1LOADREQ.PV
BDTNK1CHNGREQ.PV
BDTNK1RESETREQ.PV
BDTNK1LOADING_REQ_SW
BDTNK1CHANGING_REQ_SW
BDTNK1RESET_REQ_SW
BD TNK1 LOADING REQ SW
BD TNK1 CHANGING REQ SW
BD TNK1 RESET REQ SW
BD TNK1 LOADING REQ
BD TNK1 CHANGING REQ
BD TNK1 RESET REQ
BDTNK1LOADREQ.PV
BDTNK1CHNGREQ.PV
BDTNK1RESETREQ.PV
BD TNK1 LOADING SEL SW
BD TNK1 CHANGING SEL SW
BD TNK1 RESET SEL SW
BD TNK1 LOADING SEL SW
BD TNK1 CHANGING SEL SW
BD TNK1 RESET SEL SW
BDTNK1LOADREQ.PV
BDTNK1CHNGREQ.PV
BDTNK1RESETREQ.PV
BD TNK1 LOADING REQ
BD TNK1 CHANGING REQ
BD TNK1 RESET REQ

HAZOP STUDY REPORT OF

IB STORAGE TANKS

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

OCTOBER 2016

aether
elementally innovative



NEXA
Process Safety Engineers

AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

aether
elementally innovative

HAZOP STUDY REPORT OF

IB STORAGE TANKS

OCTOBER 2016

By

NEXA PROCESS SAFETY ENGINEERS

NEXA Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat NEXA PROCESS SAFETY ENGINEERS SURAT **Proprietor**

06/10/2016 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for IB Storage Tanks.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for IB Storage Tanks. It has 1 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	IB storage tank (110ST-003 & 110ST-004)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study

leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

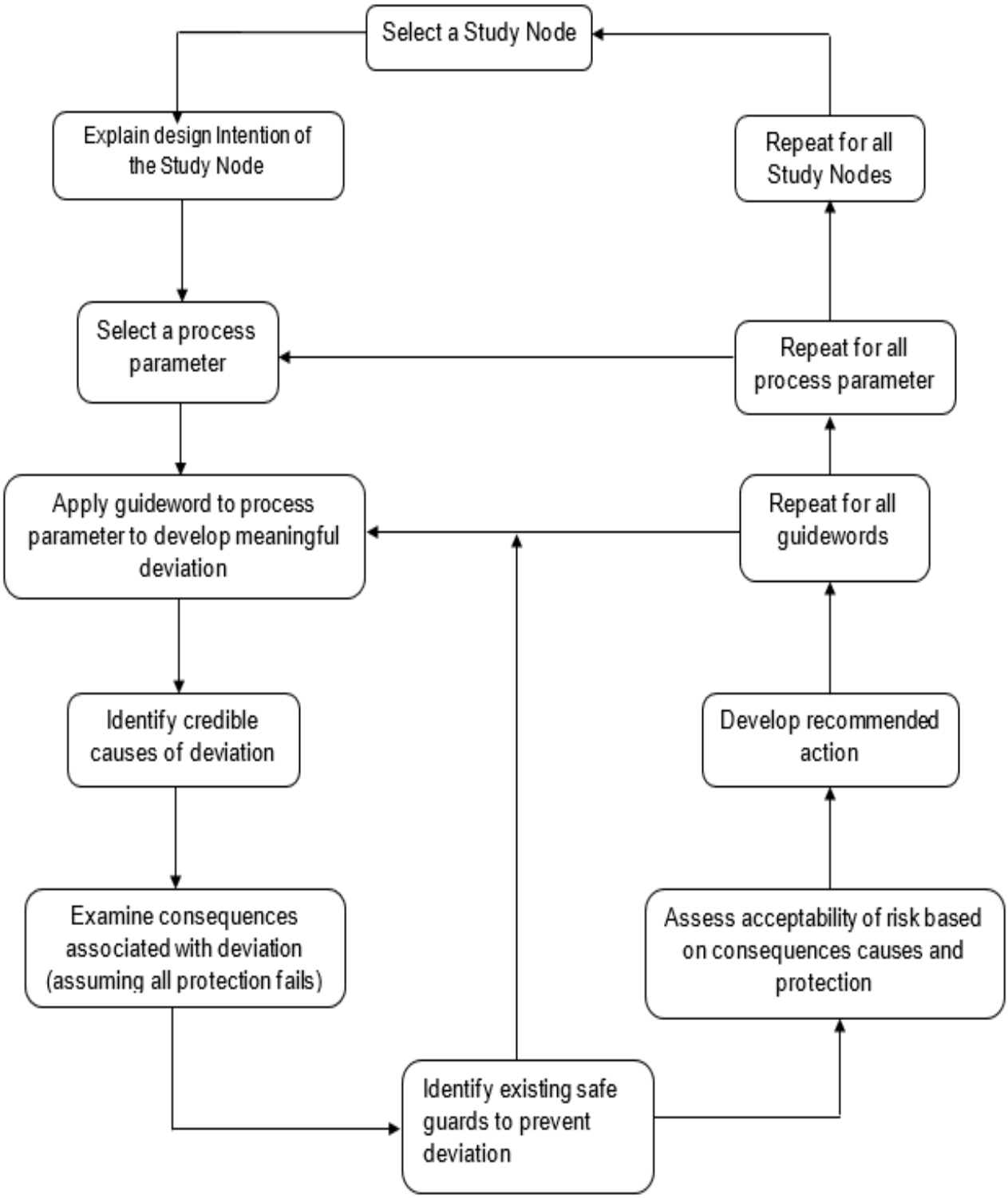
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	(110ST-003& 110ST-004)

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

"...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	IB storage tank(110ST-003 & 110ST-004)	IB storage tank(110ST-003 & 110ST-004)	1. Recommended to provide interlock to stop incoming line ROV & closed the transferring line pump at HH alarm value of LEL detector of IB tank.	Instrument

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please

refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTE

HAZOP study of IB Storage Tanks												
Title : IB Storage Tanks (110ST-003& 110ST-004)									**Plant Name: 8203 Date:-05/10/2016**			
Node	**Node Description : IB storage tank(110ST-003 & 110ST-004)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
1	Pressure	Low pressure	Human error(Vapour balance line valve is not open during transfer to plant)	Tank may implode	1.PT is available on tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up before startup.	3	3	9				
		High pressure	N2 line manual valve passed	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.PG is also installed on the tank. 3.RD with PSV in series connection is provided in the tank for overpressure protection. 4.Separate PSV is also provided in the tank. 5.Vent line of the RD & PSV is given in separate pot. 6.Flash alarm is provided on high high value of PT of the tank. 7.N2 line maximum	3	3	9				

HAZOP study of IB Storage Tanks												
Title : IB Storage Tanks (110ST-003& 110ST-004)									**Plant Name: 8203 Date:-05/10/2016**			
Node	**Node Description : IB storage tank(110ST-003 & 110ST-004)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pressure is 3kg/cm2 which is higher than design pressure.							
			Human error(Vapour balance line valve is not open during tanker unloading)		1.PT is available on tank with high and high high alarm. 2.Tank is design for up to 6 bar pressure . 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Interlock is provided to stop the IB tanker unloading pump at HH value of PT of the tank and same time transferring line ROV to be closed.	3	3	9				
2	Temperature	Low	No probable cause		TI is available on tank with low and low low alarm.							
		High	No probable cause		TI is available on tank with high and high high alarm.							

HAZOP study of IB Storage Tanks												
Title : IB Storage Tanks (110ST-003& 110ST-004)									**Plant Name: 8203 Date:-05/10/2016**			
Node	**Node Description : IB storage tank(110ST-003 & 110ST-004)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Level	Low	Tank Bottom valve left open/pass	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is provided at bottom of the tank. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification. 5.Fire water sprinkler is installed in IB tank area. 6.Spillage kit to be provide the near by area. 7.LI is available to monitor the level of storage tank. 8.LEL sensor is installed on IB tank area with alarm.	3	3	9	1. Recommended to provide interlock to stop incoming line ROV & closed the transferring line pump at HH alarm value of LEL detector of IB tank.	3	3	9
			Tank body leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	LI malfunctioning during tanker unloading	Tank may overflow	1.PM of critical instrument is performed as per predefine schedule.	3	3	9				

HAZOP study of IB Storage Tanks												
Title : IB Storage Tanks (110ST-003& 110ST-004)									**Plant Name: 8203 Date:-05/10/2016**			
Node	**Node Description : IB storage tank(110ST-003 & 110ST-004)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(more quantity is filled in tank)		1.Trained manpower is deputed for operation &Tanker quantity is verified before unloading. 2.LI is available on tank with high and high high alarm. 3.Interlock is provided to stop the IB tanker unloading pump & transferring line ROV at HH value of LI of IB tank.	3	3	9				
4	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the IB supply line. 2. Double earthing is provided to IB tank. 3. Earth rite system is provided to IB tanker during unloading . 4. Hooter is provided in the H2 PRS yard for alarming in case of earthing continuity breaks. 5.Earthing continuity testing is performed before start-up. 4. Nitrogen padding is performed in the both the	3	3	9				

HAZOP study of IB Storage Tanks												
Title : IB Storage Tanks (110ST-003& 110ST-004)									**Plant Name: 8203 Date:-05/10/2016**			
Node	**Node Description : IB storage tank(110ST-003 & 110ST-004)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					tanks to eliminate air ingress in the tank.							
		Instrument Air Failure	Air compressor failure	Tank may pressurize	1.All instruments air fail safe position is air fail to close. 2.Interlock is provided to stop the IB tanker unloading pump in case of transferring line ROV is closed.	4	3	12				
		Power failure	GEB power failure	No HSE hazard/Process Delay	DG backup provision is available.	2	1	2				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	No probable cause									

---- END OF THE REPORT -----

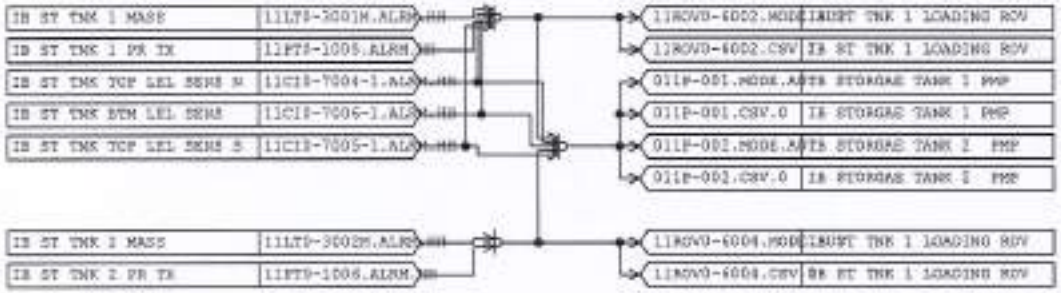
HAZOP -IB storage tanks						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	IB storage tank(110ST-003 & 110ST-004)	IB storage tank(110ST-003 & 110ST-004)	1. Recommended to provide interlock to stop incoming line ROV & closed the transfering line pump at HH alarm value of LEL detector of IB tank.	Instrument	Completed	1



Logic Chart (IBLC) IB TANK FARM LOGIC LC)

Start Timing: Periodic Execution Type(T)
Scan Period: Basic Scan
Control Period: 1
Control Phase: 0
Execution Order: Matrix Order
Direct Direction Wiring
Reverse Direction Wiring

IB STORAGE TANK 1 LOGIC



IB STORAGE TANK 2 LOGIC

PROJECT:	AILINT	FILE NAME:	IBLC.edf	SHEET:		YOKOGAWA	
STATION:	FC80101	SAVED DATE:	12/20/2023 8:24:33 PM	COMMENT:	IB TANK FARM LOGIC LC		
SECTION:		PRINTED DATE:	12/20/2023	DRAWER:			

METER INDUSTRIES LIMITED Authorised SURAT

HAZOP STUDY REPORT OF MEP PROJECT

M/S AETHER INDUSTRIES LTD.

8203 SITE, PLANT 1, SURAT

OCTOBER 2016

aether
elementally innovative



NEXA
Process Safety Engineers

M/S AETHER INDUSTRIES LTD.

8203 SITE, PLANT 1, SURAT

aether
elementally innovative

HAZOP STUDY REPORT OF

MEP PROJECT

OCTOBER 2016

By

NEXA PROCESS SAFETY ENGINEERS

NEXA Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel and his team and all other Head of the departments of respective plant for speedy completion of this report.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

11-10-2016

FOR, NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation.
- To identify significant operating or quality problems.
- To identify practical problems associated with maintenance operation.

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for MEP project.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management. The participants had a significant amount of experience in the Process Safety

Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well known as well as the required control measures to reduce risk to acceptable levels.

During the study, Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 Scope

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for MEP project. it was divided in to following 9 nodes as below:

NODE NO.	NODE DESCRIPTION
1.	Grignard Addition Reactor (013RT-006)
2.	Grignard Reaction Reactor (012RT-020)
3.	EO Day tank (012TK-014)
4.	EO coupling reactor(011RT-008)
5.	Quenching reactor (013RT-162)
6.	20% H2SO4 storage tank (010ST-224)
7.	Methylation Reactor (012RT-012)
8.	Debutylation Reactor (GLR)(011RT-013)
9.	010RT-015 (Pure MEP distillation reactor)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 Methodology

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.

9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

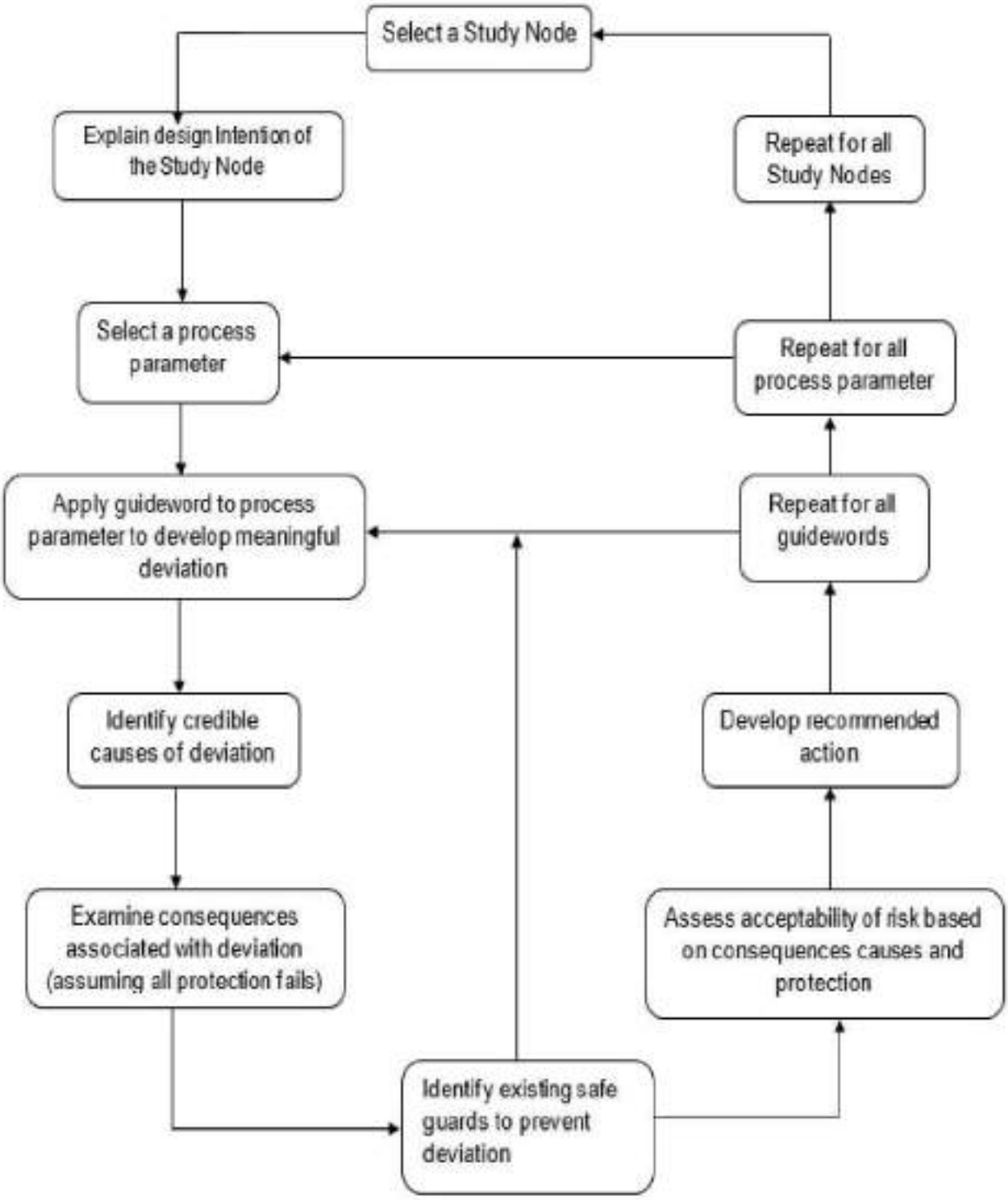
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	1- 4	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	5- 12	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	15- 25	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3-4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process accident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	<200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work / Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees.	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum / vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	PI & D / SOPS / MSDS	MEP_Plant-01 STAGE_2

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet.
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working

days of the completion of the plant HAZOP.

- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S G Patel as recorded on the HAZOP study record sheets.

SR. NO.	DATE	NAME	DISCIPLINE	COMPANY
1.	07-10-2016 & 08-10-2016	Mr. S G Patel	HAZOP Leaders	Nexa Process Safety Engineers
2.		Mr. Chetan Panchal- Electrical Mr. Rakesh Modi- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team Members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION/SPECIFIC REMARKS

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm..." Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

"...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extracts of the recommendation are summarised as below:

Sr. No.	Node No.	Node Description	Stream	Recommendations
1	1	Grignard Addition Reactor (013RT-006)	THF charging in the grignard addition reactor (013RT-006) from THF tank(030ST-013)	Vent line valve should be locked open condition with tagging.
2	5	Quenching reactor (013RT-162)	Aqueous transferring in aqueous tank(010TK-349)	Vent line valve of aqueous tank should be locked open condition with tagging.
3			Water charging in quenching reactor (013RT-162)	Vent line valve should be locked open with tagging.
4	7	Methylation Reactor (012RT-012)	DMS addition in methylation reactor (012RT-012) from DMS day tank (2KL)	Flange guard to be provided on all flanges.
5				FCV bypass valve should be locked closed condition with tagging.
6				Recommend to provide blind provision in steam supply line.
7	8	Debutylation Reactor (GLR)(011RT-013)	75% H2SO4 addition in debutylation reactor(011RT-013)	NRV to be provided in pump discharge line.
8				TCV bypass valve should be locked closed condition with tagging.
9			Solvent recovery in debutylation reactor under vacuum(011RT-013)	TCV bypass valve should be locked closed condition with tagging.
10				Vent line valve of S-5 aqueous tank should be locked open condition with tagging.
11				Vent line valve of 30KL organic tank should be locked open condition.
12			S-5 Organic transfer from debutylation S-5 organic tank(010ST-213) to organic S-5 feed tank(040ST-137)	NRV to be provided in pump discharge line.
13				Earthing jumper to be provide at flange joint.
14	9	010RT-015 (Pure MEP distillation reactor)	Pure MEP distillation in 010RT-015	TCV bypass valve should be locked closed condition with tagging.
15				Double manual valve to be provide to prevent valve passing.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as "Intolerable" "Substantial" "Moderate" "Tolerable"" Trivial".

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or "improved

operability and maintainability" categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please refer to column entitled "Action Tracking" in the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for **M/s Aether Industries Ltd., Surat**.. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with**M/s Aether Industries Ltd., Surat**.

APPENDIX-1: HAZOP MINUTES

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		BPCP charging in the grignard addition reactor (013RT-006)										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of BPCP storage tanknot opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flange guard is provided in transferring line.	3	1	3				
			Human error (manual valve of reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2. Flow meter is available in transferring line. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup. 5.Spill kit is provided in nearby area to contain spillage. 6.Compatible gasket is used to prevent gasket leakage.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Pump trip/stop	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.							
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	3	3	9				
			Low level in storage tank	No HSE hazard/Process Delay	1.Flow meter is available in transferring line . 2.LI is available on tank to monitor the level of tank.	3	1	3				
			Line/Valve chocked	No HSE hazard/Process Delay	1.Material having no chocking property.							
			Flow meter malfunctionin g	Reactor may overflow	1.Flow meter PM is performed before start up. 2.LI is also available on BPCP storagre tank to monitor the level.	3	3	9				
		High/Mor e	Human error (Wrong input in flow meter)/totalis er	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating. 2.Upper limit of totaliser is freezed as per process requirement.	2	3	6				
		Reverse	No probable cause									
		Mis-directed	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		flow										
2	Pressure	Low pressure in reactor	No probable cause									
		High	Human Error (During charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar. 5. Interlock is provided to stop the incoming pump and transferring line XV at HH value of PT of grignard addition reactor. 6.Flash alarm is provided on HH pressure of grignard addition reactor.	3	4	12				
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low flow									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4. Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2. Air compressor running indication on DCS is available.	2	1	2				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to	No HSE hazard	1.No load tripping is provided on agitator. 2.Agitator running	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			mechanical failure		indication is available on DCS.							
Stream-2		THF charging in the grignard addition reactor (013RT-006) from THF tank(030ST-013)										
7	Quantity/Flow	No/Less	Human error (Tank bottom valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3. Line pressure testing is done before start up. 4. LI is available on tank to monitor the level of tank.	2	2	4				
			Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	2	2	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2. Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in nearby area. 6.All electrical equipment are flameproof in nearby	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area.							
			No level in tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available on tank to monitor the level of tank.	3	1	3				
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available on reactor with high and high high alarm. 2. Interlock is provided to stop the incoming pump at HH value of PT of grignard addition reactor. 3.Flash alarm is provided on HH pressure of grignard addition reactor.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Vent line flame arrestor chocked		1. Flame arrestor PM is performed as per PM schedule. 2. Choking property material is not available.	2	4	8				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Trained manpower deputed for DCS operating. 2. Upper limit is freezed in the totaliser to prevent more charging.	2	2	4				
		Reverse	No probable cause									
		Mis-directed flow										
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is provided to stop charging pump and charging line ROV at HH pressure of the reactor. 4. Flash alarm is provided	3	4	12	1. Vent line valve should be locked open condition with tagging.	2	4	8

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					at HH pressure of the reactor.							
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	2	4	8				
9	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
10	Level	Low	Reactor Bottom valve left open/pass	Health & Fire hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2. Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2. Air compressor running indication on DCS is available. 3.THF charging line ROV air failed safe position is to be air tailed to closed condition. 4. Interlock is provided to stop the charging pump when transferring line ROV closed.	3	1	3				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 1		Node Description: Grignard Addition Reactor (013RT-006)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard	1.No load tripping is provided on agitator. 2. Agitator running indication is available on DCS.	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Mg turnings charging into grignard reactor(012RT-020)										
1	Quantity/Flow	No/Less	Human Error (Less Quantity charged)	No HSE hazard	1. Fixed quantity of material will be issued from the store batchwise. 2. Weigh balance calibration is doing at every day.	2	2	4				
			Wrong measured quantity supplied from store department	No HSE hazard	Issue slip & physical verification of quantity is done before start-up.	2	2	4				
			Human Error (Spillage)	Health hazard & fire hazard due to spillage	1. Full body air supply suit is wear by person during charging. 2. Trained manpower will be deputed for this activity. 3. Hopper with valve will be used for charging. 4. Spill kit is provided to contain spillage. 5. Area barrication is done to restrict man movement during charging.	3	3	9		2	1	2

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Human Error(More Quantity charged)	No HSE hazard	1. Fixed quantity of material will be issued from the store batchwise. 2. Issue slip & physical verification of quantity is done before start-up. 3. Trained manpower will perform the activity.	3	1	3				
			Wrong measured quantity supplied from store department									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	Not Applicable									
		High	Not Applicable									
3	Temperature	Low	Not Applicable									
		High	Not Applicable									
4	Level	Low	Not Applicable									
		High	Not Applicable									
5	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1.Material is verified by production supervisor with material code.							

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
6	Other	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed while charging in the reactor. 2. Double earthing is provided in the reactor. 3. Earthing continuity is ensured before start-up. 4. Suitable PPE's are available. (Goggles, Face shield, Hand gloves, Dust Mask) 5.Hopper is available for charging. 6.Earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Not Applicable	No HSE hazard								
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard	1.No load tripping is provided on agitator. 2.Agitator running indication is available on DCS.	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-2		Heating in grignard reactor (042RT-073)										
7	Quantity/Flow	No/Less	No probable cause	-	-				-			
		High/More	No probable cause	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
8	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Ventline is provided in reactor & ensure before startup that valve is open condition. 5.RD is available in the reactor which is connected	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					to catch pot. 6.PT is available in reactor with high and high high alarm. 7.Manual valve is available in line of TCV. 8. Flash alarm is provided on HH value of PT of the reactor.							
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
			Human error(Manual vent line/vapour line valve is not open of		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			reactor)		reactor. 3.Vent line/vapour line valve is always locked open condition with tag. 4.Interlock is provided to closed the steam TCV at HH value of PT of the reactor.							
9	Temperatu re	Low	Human error(cooling water supply valve open)	No HSE hazard/Proces s Delay	1.Trained manpower will operate the operation. 2.ROV is available in cooling supply and return line of jacket of reactor.	3	1	3				
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm. 5.Flash alarm is provided on HH value of RTD of the reactor.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 2.Trained manpower is deputed for DCS operation. 3.Interlock is provided to closed the steam TCV at given set point in TI of reactor. 4. upper limit of TCV set value is freeze as per process requirement.	3	4	12				
			Human error(TCV bypass line passed/open)		1.TCV bypass valve should be locked closed condition with tagging.	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of RTD is performed before startup.	3	4	12				
10	Level	Low	No probable cause									
		High	Jacket puncture of the reactor	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of jacket is performed periodically.	3	3	9				
11	Compositio	Other	No probable									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
	n	than	cause									
12	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is to be air fail to close.	3	4	12				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in reactor	1.Steam TCV is closed in case of agitator stop/trip. 2.No load tripping is provided on agitator.	3	4	12				
Stream-3		THF + BPCP addition in grignard reactor (012RT-020) from grignard addition reactor (013RT-006)										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of grignard addition reactor valve not opened). Human error (manual valve of grignard reactor not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	2	6				
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3.Fire extinguisher and fire hydrant point is provided in near by area. 4. Flange guard is provided	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					on all flanges. 5.Compatible gasket issued. 6.All electrical installation as per HAC classification.							
			Low level in grignard addition reactor	No HSE hazard/Process Delay	Flow meter is available in addition line .	3	2	6				
			Flow meter malfunctioning/ chocked	Process delay	1.Flow meter PM to be performed before start the operation.	3	2	6				
			Human error(vent line valve not opened of grignard reactor)	Reactor may pressurse	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.PT is available on reactor with high and high high alarm. 3.Reactor design pressure is upto 6 bar. 4. interlock is provided to closed addition line FCV at HH pressure of grignard reactor. 5.Flash alarm is provided on HH pressure of reactor.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(vent line valve not opened of grignard addition reactor)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Vent line valve is always locked open condition with tagging.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. TI is available in the reactor with high and high high alarms. 3. Cooling water provision is available in jacket of the reactor to control temperature. 4. Flash alarm is provided at HH temperature of reactor TI. 5. Interlock is provided to closed CV at set value of totaliser. 6. Upper limit of the flow meter & totaliser is freezed as per process requirement. 7. Interlock is provide to	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					closed addition CV at HH temperature of reactor.							
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Vent line of grignard reactor valve not opened) during addition	Reactor may pressurise	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the reactor with HH alarms. 3. Vent line valve is critical locked open with tag. 4. Interlock is provided to close addition line CV at HH pressure of the reactor. 5.Flash alarm is provided on HH value of PT of the grignard reactor.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Vent line of grignard catch pot valve not opened) during addition		1. catch pot is designed pressure to 6 bar pressure. 2. PT is available on the catch pot with HH alarms. 3. Vent line valve is critical locked open with tag. 4. Interlock is provided to close addition line CV at HH pressure of the catch pot.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Double valve is provided in N2 supply line.	3	4	12				
			Flame arrestor chocked		1.PM of flame arrestor is performed before startup. 2.Material having no chocking property.	3	4	12				
			TCV passed		PM of TCV is performed before start up.	3	4	12				
			Human error(steam bypass valve passed/left open)		1.Trained manpower is deputed for operation. 2.Bypass line valve should be critical locked closed condition with tagging.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Fast addition rate		Refer high flow safeguard	3	4	12				
			Jacket puncture of the reactor		PM of the reactor is performed before startup and also as per predefine schedule.	2	4	8				
			Tube leakage in condenser		Pressure testing of condenser is performed before startup .	2	4	8				
15	Temperature	Low	Cooling/Chilling water supply valve opened/passed	No HSE hazard								
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4.RTD is available in reactor with high and high high alarm. 5.Flash alarm is provided on HH value of RTD of the reactor.							
			Human error(TCV bypass line passed/open)		1.TCV bypass valve should be locked closed condition with tagging.	3	4	12				
			Fast addition rate		1.Flowmeter & totaliser is available in the addition line. 2.Upper limit of flowmeter and totaliser is freeze as per process requirement. 3.Interlock is provided that at HH temperature of reactor addition line CV to be closed. 4.Flash alarm is provided on HH temperature of the reactor.	3	4	12				
			Jacket puncture of the reactor		PM of the reactor is performed before startup and also as per predefine schedule.	2	4	8				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tube leakage in condenser		Pressure testing of condenser is performed before startup .	2	4	8				
16	Level	Low	Reactor Bottom valve left open/pass	health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tube bundle leakage of the reactor	No HSE hazard	1.Before startup thickness testing is performed. 2.Compatible utility is used.	3	3	9				
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Grignard mas addition line CV air failed safe position is air failed to closed condition.	2	4	8				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 2		Node Description : Grignard Reaction Reactor (012RT-020)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in reactor	1. No load tripping is provided on agitator. 2. Grignard addition line CV is closed in case of agitator stop/trip.	2	4	8				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		EO transferring in EO day tank (012TK-014) from EO storage tank										
7	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2. Flow meter is available in transferring line .	3	2	6				
			Human error (receiving line on reactor valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3. Line pressure testing is done before start up.	2	4	8				
			Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank with low and low low alarms.	2	2	4				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					in near by area. 6.All electrical equipment are flameproof in near by area. 7.EO detector is available near day tank. 8.Spill kit is provided in the nearby area to contain spillage. 9.Interlock is provided to closed EO transferring line ROV at high high value of EO sensor of EO day tank. 10.Flash alarm is provided at HH value of EO detector sensor.							
			No level in tank	No HSE hazard	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line. 3.Interlock is provided to close the transferring line ROV at LL value of LI of storage tank.	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				
		High/More	Human error (Wrong input in totaliser)	Day tank may overflow	1.Trained manpower is deputed for DCS operation. 2.Day tank vent is given in dumped tank. 3.Loadcell is available on day tank with high and high high alarm. 4.LSH is available on day tank. 5.Upper limit is freezed in the totaliser to prevent more transferring of EO. 6. Interlock is provided to close ROV at given set value achieve in totaliser. 7.Interlock is provided to closed EO transferring line ROV at HH value of loadcell of EO day tank. 8.Flash alarm is provided on HH value of loadcell of EO day tank.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					9. Interlock is provided to closed transferring line ROV at LSH activation. 10.Flash alarm is provided on LSH activation.							
		Reverse										
		Mis-directed flow	Human error(Wrong line up)	Line may pressurize	1. Double manual valve is available at toluene header. 2.Trained manpower is deputed for operation. 3.identification is done on transferring line at main header of EO.	3	4	12				
8	Pressure	Low	No probable cause									
		High	N2 line manual valve passed/left open	Day tank may pressurise	1.Double manual valve is provided in N2 line. 2.Tank design pressure is upto 6 bar. 3.PRV is available in main nitrogen line. 4.Pressure transmitter is available with high and high high alarm. 5.PSV is available on day	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					tank. 6.Flash alarm is provided on high high pressure of the day tank. 7.Interlock is provided to closed the transferring line ROV at HH pressure of the day tank.							
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Chilling circulation failure due to chiling plant issue	Tank may pressurise due to temperature rise in day tank	1.TI is available on day tank with high and high alarm. 2.TI is available in chilling water return line with high high alarm. 3.Chilling plant pump trip/stop indication is available on DCS with alarm. 4.Flash alarm is provided on high high temperature of the day tank. 5.Interlock is provided to closed the transferring line ROV at HH temperature of the day tank.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
10	Level	Low	Loadcell malfunction	No HSE hazard/Process Delay	PM of loadcell is performed before startup.	2	3	6				
			Bottom valve leakage/passed	Health hazard & fire hazard due to spillage	1.SS compatible valve and metallic gasket is used. 2.Preventive maintenance is carried out at regular interval. 3.Double manual valve is provided on bottom of the tank.	2	3	6				
			Line/Flange leakage		Line pressure test is performed before start up.	2	3	6				
			Tank leakage		Tank thickness testing and PM is done at defined frequency.	2	3	6				
		High	Refer High/More flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : EO Day tank(012TK-014)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.ROV of EO transferring line air failed safe position is air failed to closed.	2	3	6				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Toluene charging in EO coupling reactor (011RT-008)										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1. Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2. Flow meter is available in transferring line .	3	1	3				
			Human error (receiving line on reactor valve not opened).	Line may pressurze	1. Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3. Line pressure testing is done before start up.	3	2	6				
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					extinguisher are available in nearby area. 6.All electrical equipment are flameproof in nearby area. 7.Spill kit is provided in the nearby area to contain spillage.							
			No level in tank	No HSE hazard	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line. 3.Interlock is provided to stop the transferring pump at LL value of LI of storage tank.	2	1	2				
			Human error (Vent line of reactor valve not opened)	Reactor may pressurize	1.PT is available with high and high high alarm. 2.PG is also provided on reactor. 3.Trained manpower is deputed for operation. 4.Reactor design pressure upto 6bar. 5. Vent line valve is locked open condition with tagging. 6. interlock is provided to	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					stop the incoming pump and same time ROV to be closed of toluene transferring line at HH value of PT of the reactor.							
			PVRV chocked of U/G tank	Tank may implode	1.PM of PVRV is performed as per schedule. 2.PT is provided on tank. 3.Tank is design for full vacuum.	3	4	12				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow	1.Trained manpower is deputed for DCS operation. 2.Upper limit is freezed in the totaliser to prevent more charging of toluene. 3.Interlock is provided to stop the pump at given set value achieve in totaliser.	2	2	4				
		Reverse										
		Mis-directed flow	Human error(Wrong line up)	Line may pressurize	1. Double manual valve is available at toluene header. 2.Trained manpower is	2	2	4				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					deputed for operation. 3.Proper identification of transferring line is done at main header of toluene.							
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Vent line valve is locked open condition with tagging. 4. Interlock is provided to stop charging pump & ROV of transferring line is closed at HH pressure of the reactor. 5. Flash alarm is provided at HH pressure of the reactor.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left	Health hazard & fire hazard	Trained manpower and SOP is available before line	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			open/pass	due to spillage	up.							
			Line leakage		1. Line pressure testing is done before start-up. 2. Compatible gasket is used. 3. Spill kit is provided at nearby area to contain the spillage. 4. Flange guard is provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
			Refer low flow									
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2. Earthing jumper is provided in flange joint.	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure	Air compressor failure	Line may pressurze	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.ROV of toluene transferring line air failed safe position is air failed to closed. 4.Interlock is provided to stop the pump of Toluene transferring when ROV is closed.	2	3	6				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		Grignard mass (S-2) transferring in EO coupling reactor(042RT-075) by N2 pressure										
7	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard/Process Delay								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	High pressure of N2 in N2 line	No HSE hazard/Process Delay								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause	No HSE hazard								
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurize	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.N2 line maximum pressure is 3 kg/cm2. 4.Double valve is provided in N2 supply line.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Manual vent line/vapour line valve is not open of reactor)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available in reactor with high and high high alarm. 3.Vent line/vapour line valve is always locked open condition with tag. 4.Flash alarm is provided on HH value of PT of the reactor.	3	4	12				
9	Temperatu re	Low	Human error(Brine supply valve open)	No HSE hazard/Proces s Delay	TI is available on reactor with low and low low alarm	3	1	3				
		High	Human error(Steam manual valve open/passed)	Temperature rise in reactor	1.TI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation. 3.Flash alarm is provided on HH value of TI of reactor. 4.Stem line is blinded to avoid human error.	3	4	12		2	4	8

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in nearby area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tube bundle leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of tube bundle is performed periodically. 3. Incompatible hazard is not there between utility media and reaction mass.	3	3	9				
11	Composition	Other than		No HSE hazard								
12	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3. Earthing continuity is verified before start up.	3	3	9				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-3		EO addition in EO coupling reactor (042RT-075) from EO day tank (2KL)										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of EO day tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	2	6				
			Human error (manual valve of EO receiving line on EO coupling reactor not opened).									
			Low pressure of N2 in EO day tank	No HSE hazard/Process Delay	1.PT is available in day tank with low and low low alarm.							

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4	Node Description: EO coupling reactor(011RT-008)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Fire extinguisher and fire hydrant point is provided in near by area. 3. Flange guard is provided on all flanges. 4.Compatible gasket issued. 5.All electrical installation as per HAC classification. 6.Spill kit is provided at nearby area to contain the spillage. 7.EO detector is provided on coupling reactor and also indication provide on DCS with alarms and flameproof hooter. 8. Interlock is provided to closed EO addition line FCV at HH value of EO detector. 9.Flash alarm is provided on HH value of EO detector.	3	3	9				
			Low level in EO day tank(2KL)	No HSE hazard/Process Delay	1.Flow meter is available in addition line . 2.Loadcell is available in EO day tank with alarms.	3	2	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flow meter malfunctioning/ chocked	Process delay	1.Flow meter PM to be performed before start the operation. 2.Flow meter PM is performed as per predefined schedule. 3. Choking not possible.	3	2	6				
			FCV of EO addition line stuck	No HSE hazard/Process Delay	PM of FCV is performed as per schedule.							
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 3. TI is available in the reactor with high and high high alarms. 4. CHBS provision is available in jacket of the reactor to control temperature. 5. Flash alarm is provided at HH temperature of reactor TI. 6. Interlock is provided to open brine supply & return line ROV at HH temperature of reactor. 7. Interlock is provided to closed FCV at set value of	3	4	12		3	4	12

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					totaliser. 8. Upper limit of the flow meter & totaliser is freezed as per process requirement. 9. Interlock is provided to closed addition FCV at HH temperature of reactor. 10.interlock is provided to closed EO addition line FCV at LL value on brine supply line flow meter.							
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened) during addition	Reactor may pressurise	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the reactor with HH alarms. 3. Vent line valve is critical locked open with tag. 4. Interlock is provided to	3	4	12		2	4	8

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					close addition line FCV at HH pressure of the reactor.							
			FCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5. Flash alarm is provided at HH pressure of the reactor.	3	4	12		2	4	8
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Double valve is provided in N2 supply line.	3	4	12				
			Human error(EO addition rate fast)		Refer high flow safeguard	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Failure of brine circulation in jacket of the reactor		1.Flow meter is available in brine supply line with low and low low alarm. 2.Brine circulation pump running indication is available on DCS. 3.Interlock is provided to closed EO addition line FCV at LL value on brine supply line flow meter.	3	4	12				
			Utility failure in tube bundle of coupling reactor		1.Flow meter is available in brine supply line with low and low low alarm. 2.Brine circulation pump running indication is available on DCS.	3	4	12				
15	Temperature	Low	Brine supply valve opened/passed	No HSE hazard								
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation.	3	4	12				
			FCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure &	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5. Flash alarm is provided at HH pressure of the reactor.							
			Human error(FCV bypass line passed/open)		1.Trained manpower is deputed for operation. 2.TCV bypass valve is locked closed condition with tagging.	3	4	12				
			Fast additon rate		Refer high flow safeguard							
16	Level	Low	Reactor Bottom valve left open/pass	health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4. Flange guard to be provided on all flanges. 5. Fire extinguisher and fire hydrant point is provided in nearby area. 6.All electrical installation as per HAC classification.							
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Tube bundle leakage of the reactor	No HSE hazard	1. Before startup thickness testing is performed. 2. Compatible utility is used.	3	3	9				
17	Composition	Other than	No probable cause									
18	Other	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is	2	4	8				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description: EO coupling reactor(011RT-008)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					available. 3.EO addition line FCV air failed safe position is air failed to closed condition.							
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1. No load tripping is provided on agitator. 2. EO addition line FCV is closed in case of agitator stop/trip.	2	4	8				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Reaction mass transfer to quenching reactor (013RT-162) by pump										
1	Quantity/Flow	No/Less	Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available on reactor with high and high high alarm. 2.Interlock is provided to stop the transferring pump and transferring line XV at HH value of PT of quenching reactor. 3.Flash alarm is provided on HH pressure of quenching	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					reactor.							
			No level in EO coupling reactor	No HSE hazard/Process Delay	1.Batch wise fixed quantity of material is taken in EO coupling reactor.	2	1	2				
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurise	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.N2 line maximum pressure is 3 kg/cm2. 4.Double valve is provided in N2 supply line. 5.Flash alarm is provided at HH pressure of reactor.	3	4	12				
			Human error(Manual vent line/		1.Trained manpower will operate the operation. and ensure valve position before	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			vapour line valve of quenching reactor is not open)		start operation. 2.Vent line/vapour line valve is always locked open condition with tag.							
3	Temperature	Low	Human error(Chilling water supply valve open)	No HSE hazard/Process Delay								
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm and interlock is also available. 5.Flash alarm is provided on HH value of RTD of the reactor. 6. Blind is provided in steam supply line of quenching reactor.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (TCV bypass line passed/open)		1.TCV bypass valve is locked closed condition with tagging.	3	4	12				
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor leakage	Incompatible hazard may possible.	PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
5	Composition	Other than		No HSE hazard								
6	Other	Static Electricity		Fire hazard	1. Dual earthing is provided in the reactor & tantalum plug is also provided. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Reaction mass transferring line ROV air failed safe position is air failed to closed condition.	2	1	2				
		Power Failure	GEB failure	No HSE hazard	DG is available for power backup.	2	1	2				
		DCS	GEB failure	No HSE	Battery bank backup is	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Failure		hazard	provided and PM is done for the same periodically.							
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard	1.No load tripping is provided on agitator.	2	1	2				
Stream-2		20% H2SO4 charging in quenching reactor (013RT-162)										
7	Quantity/Flow	No/Less	Human error (Discharge manual valve not opened).	No HSE hazard/Process Delay	Trained manpower is deputed.	3	3	9				
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket is used. 3.Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms. 3. Vent line valve is locked open condition with tagging.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4.Interlock is provided to closed H2SO4 addition line CV at HH value of PT of reactor.							
			Low level in 15% H2SO4 tank	No HSE hazard								
			Flow meter malfunction	Process delay	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	1. Exotherm may possible in the reactor and fumes may space through vent line of reactor. 2. Overflow from reactor may lead to spillage hazard	1. Flow meter PM to be done periodically. 2. TI is available in the reactor with high and high high alarms. 3. Chilling & cooling utility supply provision is available to control temperature. 4.Flash alarm is provided at HH temperature of reactor TI. 5. Interlock is provide to close CV at set value of totaliser. 6. Upper limit of the flow meter & totaliser is freezed. 7. Interlock is provided to close CV at HH temperature	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					of reactor. 8. Spill kit is provided at nearby area to contain the spillage.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms. 3. Vent line valve is locked open. 4. Interlock is provided to close addition line CV at HH pressure of the reactor. 5.Flash alarm is provided on HH value of PT of the reactor.	3	4	12				
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
9	Temperature	Low	CHWS valve opened/pass	No HSE hazard								
		High	Human Error (Manual valve of utility supply & return not opened)	Exotherm may possible in the reactor	1. Trained manpower and SOP is available to line up chilling water before solvent charging. 2. Interlock is available to close addition line CV at HH value of TI in reactor. 3. TI is available in the reactor and utility return & supply line with high and high high alarms. 4. Upper limit of the flow meter & totaliser to be freezed. 5.Flash alarm is provided at HH temperature of reactor TI.	3	4	12				
			TI malfunction		TI is available in the utility supply & return line with high and high high alarms.	3	4	12				
			More quantity of H2SO4 charge in reactor		Refer high flow	3	4	12				
10	Level	Low	Reactor Bottom valve left	Health hazard due to spillage	Trained manpower and SOP is available before line	2	4	8				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			open/pass		up.							
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	4	8				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	4	8				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	No HSE hazard								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.H2SO4 addition line FCV air failed safe position is air failed to closed condition.	2	4	8				
		Power Failure	GEB power failure	No HSE hazard								
			DG failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	Exotherm may possible	1.No load tripping is available. 2.Interlock is provided to stop H2SO4 addition line CV at tripping/stop of agitator.	3	4	12				
Stream-3		Aqueous transferring in aqueous tank(010TK-349)										
13	Quantity/Flow	No/Less	Line leakage	No HSE hazard/Process Delay	1.Line pressure testing is done before start-up. 2.Compatible gasket is used. 3.Spill kit to be provided at nearby area to contain the	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					spillage. 4. Flange guard to be provided on all flanges.							
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High pressure in 6.3KL aqueous tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with high and high high alarm. 3.Flash alarm is also provided on HH value of PT of the tank. 4.Vent line valve is locked open condition with tagging.	3	4	12	1.Vent line valve of aqueous tank should be locked open condition with tagging.	2	4	8
15	Temperature	Low	No probable cause	No HSE hazard		3	1	3				
		High	No probable	No HSE								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			cause	hazard								
16	Level	Low	Aqueous tank leakage, aqueous transferring line valve pass/leakage	No HSE hazard	1.Double valve is provided at bottom of the tank.	2	1	2				
		High	More aqueous charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.Level switch is available in tank . 3.Flash alarm is provided on HH value of LI and LSH activation of aqueous tank.	2	3	6				
17	Composition	Other than	No probable cause									
18	Others	Static charge	No probable cause	No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	No probable cause									
Stream-4		Water charging in quenching reactor (013RT-162)										
19	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow.	2	2	4				
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms.	3	4	12	1. Vent line valve should be locked open with tagging.	2	4	8
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Upper limit of totaliser to be freeze as per process requirement. 2.Interlock is provided to closed the water transferring line ROV at set value achieved in totaliser.	3	2	6				
			Flow meter malfunction		1.Flow meter PM is performed as per	3	2	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1				
Node 5	Node Description : Quenching reactor(013RT-162)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					predefined schedule.							
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
20	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor.	3	4	12				
21	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
22	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage.	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1				
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4. Flange guard to be provided on all flanges.							
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
23	Composition	Other than	No probable cause	No HSE hazard								
24	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	-	No HSE								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
				hazard								
Stream-5		Na2CO3 charging into reactor (013RT-162) through hopper										
25	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	2	1	2				
		High/More	Human Error (More quantity charged)	No HSE hazard	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	2	1	2				
		Mis-directed flow	No probable cause									
26	Pressure	Low	No probable cause									
		High	No probable cause									
27	Temperature	Low	No probable cause									
		High	No probable cause									
28	Level	Low	NA									
		High	NA									
29	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard	1. Material issue slip is verified by plant person. 2. Checklist is filled before material charging .	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
30	Others	Static charge	-	No HSE hazard								
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Not applicable									
Stream-6		2nd Aqueous transferring in aqueous tank(010TK-349)										
31	Quantity/Flow	No/Less	Line leakage	No HSE hazard/Process Delay	1.Line pressure testing is done before start-up. 2.Compatible gasket is used. 3.Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	3	1	3				
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
32	Pressure	Low	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High pressure in 6.3KL aqueous tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with high and high high alarm. 3.Flash alarm is also provided on HH value of PT of the tank. 4.Vent line valve is locked open condition with tagging.	3	4	12	1.Vent line valve of aqueous tank should be locked open condition with tagging.	2	4	8
33	Temperature	Low	No probable cause	No HSE hazard		3	1	3				
		High	No probable cause	No HSE hazard								
34	Level	Low	Aqueous tank leakage, aqueous transferring line valve pass/leakage	No HSE hazard	1.Double valve is provided at bottom of the tank.	2	1	2				
		High	More aqueous charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.Level switch is available in tank . 3.Flash alarm is provided on HH value of LI and LSH	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 5	Node Description : Quenching reactor(013RT-162)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					activation of aqueous tank.							
35	Composition	Other than	No probable cause									
36	Others	Static charge	No probable cause	No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									
Stream-7	Organic transferring in organic tank(010ST-214)											
37	Quantity/Flow	No/Less	Line leakage	Health hazard and fire hazard may possible	1. Fire hydrant points& fire extinguisher are available in nearby area. 2. All electrical equipment are flameproof in nearby area.	3	3	9				
		High/More	No probable cause									
		Reverse	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Mis-directed flow	No probable cause									
38	Pressure	Low										
		High	PVRV malfunctioning	Tank may pressurize	1. PM of PVRV is performed as per schedule. 2. PT is available with HH alarms. 3.ESH is also available on tank. 4. Flash alarm is provided on HH alarm of PT of the organic tank.	3	4	12				
			N2 line PRV failure		1. PM of PRV is performed as per predefine schedule. 2. PVRV is available on tank. 3.ESH is also available on tank.	3	4	12				
39	Temperature	Low	No probable cause	No HSE hazard		3	1	3				
		High	No probable cause	No HSE hazard								
40	Level	Low	Organic tank leakage, Organic transferring line	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 5		Node Description : Quenching reactor(013RT-162)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			valve pass/leakage		are flameproof in nearby area.							
		High	More organic charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.Level switch is available in tank . 2.Flash alarm is provided on HH alarm of LI of tank and also LSH activation of tank.	3	3	9				
41	Composition	Other than	No probable cause									
42	Others	Static charge	No probable cause	No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 6		Node Description: 20% H2SO4 storage tank (010ST-224)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream -1		20%H2SO4 transferring in storage tank(010ST-224) from H2SO4 storage tank(030ST-162)										
1	Quantity/Flow	No/Less	Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.Spill kit is provided in nearby area to contain spillage.	3	3	9				
			Human Error (Manual Valve not opened on storage tank)	Line may pressurise	1.Loadcell is available on tank to monitor the level of the tank. 2.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9				
			Human error(Storage tank vent valve is not open)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.Vent line manual valve is in critical locked open condition with LO tag.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 6		Node Description: 20% H2SO4 storage tank (010ST-224)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3.PT is available in tank with high and high high alarm. 4.Interlock is provided to stop the transferring pump and closed XV at HH pressure of the tank. 5.Flash alarm is provided on HH value of PT of the tank.							
			No/less material quantity in storage reactor	No HSE hazard/Process delay	1.Loadcell is available on tank to monitor the level of the tank.	3	1	3				
		High/More	Loadcell malfunctioning	Overflow from day tank may lead to gas/liquid exposure due to spillage.	1.Level switch is available in day tank. 2.Calibration of Loadcell to be performed before start up. 3.Interlock is provided to closed the transferring line ROV & pump in case of level switch activation. 4.Flash alarm is provided on level switch activation.	3	3	9				
			Level switch malfunctioning		1.Loadcell is available in day tank with high and high	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 6		Node Description: 20% H2SO4 storage tank (010ST-224)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					alarm. 2.Testing of Level switch to be performed before start up. 1.Interlock is provided to closed the transferring line ROV & pump at HH value of Loadcell of oleum day tank.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	No probable cause	-	-				-			
		High	Human error(Storage tank vent valve is not open)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.Vent line manual valve is in critical locked open condition with LO tag. 3.PT is available in tank with high and high high alarm. 4.Interlock is provided to stop the transferring pump	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1				
Node 6		Node Description: 20% H2SO4 storage tank (010ST-224)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					and closed XV at HH pressure of the tank. 5.Flash alarm is provided on HH value of PT of the tank.							
3	Temperature	Low	No credible cause	-	TI is available in day tank with low and low low alarms							
		High	No credible cause	-	TI is available in day tank with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Day tank body leakage	Gas/Liquid Exposure due to spillage	1.Day tank MOC is compatible with material. so leakage is not possible. 2.Thickness testing of reactor is performed as per predefined schedule.	3	3	9				
			Day tank FBV passed/leakage		1.Double manual valve is available at bottom of the reactor.	3	3	9				
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity		No HSE hazard								
		Instrume	Air	Day tank may	1.Air buffer tank is available	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 6		Node Description: 20% H2SO4 storage tank (010ST-224)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		nt Air failure	compressor failure	overflow	with PT and alarms. 2.Air compressor running indication on DCS is available. 3.1.Transferring line XV air failed safe position is to be air failed to close.							
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		DMS transferring in DMS day tank (013TK-019) from DMS storage tank(030ST-011)										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line	3	2	6				
			Human error (receiving line on day tank valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	3	6				
			Line leakage	Health hazard, Hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9				
			No level in tank	No HSE hazard	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in	2	1	2				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					transferring line.							
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				
		High/More	Human error (Wrong input in totaliser)	Day tank may overflow	1.Trained manpower is deputed for DCS operation. 2.Vent is provided in day tank. 3.Loadcell is available on day tank with high and high high alarm. 4.LSH is available on day tank. 5.Upper limit is freezed in the totaliser to prevent more transferring in day tank. 6.Interlock is provided to stop pump & close ROV after 10sec of pump stop at given set value achieve in totaliser. 7.Interlock is provided to stop pump & close ROV after 10sec of pump stop at HH value of loadcell of the day tank.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					8.Flash alarm to be provide on HH value of loadcell of DMS day tank. 9.interlock is provided to stop pump & close ROV after 10sec of pump stop at LSH activation. 10.Flash alarm is provided on LSH activation.							
		Reverse										
		Mis-directed flow	Human error(Wrong line up)	Line may pressurize	1. Double manual valve is available at toluene header. 2.Trained manpower is deputed for operation.	3	3	9				
2	Pressure	Low	No probable cause									
		High	Human error(manual vent line valve is closed)	Day tank may pressurise	1.Trained manpower is deputed for operation. 2.Tank is design for up to 6 bar pressure. 3.Vent line valve is critical locked open condition with tagging.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
4	Level	Low	Loadcell malfunction	No HSE hazard/Process Delay	PM of loadcell is performed before startup.	2	3	6				
			Bottom valve leakage/passed	Health hazard, Hazard due to spillage	1.SS compatible valve and metallic gasket is used. 2.Double manual valve to be provide on bottom of the tank.	2	3	6				
			Line/Flange leakage		Line pressure test is performed before start up.	2	3	6				
			Tank leakage		Tank thickness testing and PM is performed at defined frequency.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.ROV of DMS transferring line air failed safe position is	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					air failed to closed. 4.Interlock is provided to stop the DMS transferring pump ,when ROV is closed.							
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		DMS addition in methylation reactor (012RT-012) from DMS day tank (2KL)										
7	Quantity/Flow	No/Less	Human error (Bottom manual valve of DMS day tank not opened). Human error (manual valve of DMS receiving line on methylation reactor not	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line . 3.Load cell is available in DMS day tank to monitor the level of day tank.	3	2	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			opened).									
			Line leakage	Health hazard, Hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket issued.	3	3	9	1. Flange guard to be provided on all flanges.	2	3	6
			Low level in DMS day tank(2KL)	No HSE hazard/Process Delay	1.Flow meter is available in addition line . 2.Load cell is available in DMS day tank with alarms.	3	2	6				
			Flow meter malfunctioning /checked	Process delay	1.Flow meter PM is performed as per predefined schedule. 2. Material having no choking property.	3	2	6				
			FCV of DMS addition line stuck	No HSE hazard/Process Delay	PM of FCV is performed as per schedule.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. TI is available in the reactor with high and high high alarms. 3. Cooling water & chilling water provision is available in jacket of the reactor to control temperature. 4. Flash alarm is provided at	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1				
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					HH temperature of reactor TI. 5. Interlock is provided to closed FCV at set value of totaliser. 6. Upper limit of the flow meter & totaliser is freezes as per process requirement. 7. Interlock is provided to closed addition FCV at HH temperature of reactor.							
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
			FCV of DMS addition line stuck		PM of FCV is performed as per schedule.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the reactor with HH alarms.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			during addition		3. Vent line valve is critical locked open with tag. 4. Interlock is provided to close addition line FCV at HH pressure of the reactor.							
			FCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5. Flash alarm is provided at HH pressure of the reactor.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Double valve is provided in N2 supply line.	3	4	12				
			Human error(DMS addition rate fast)		Refer high flow safeguard	3	4	12				
9	Temperatu	Low	Chilling supply	No HSE hazard								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
	re		valve opened/passed									
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation.	3	4	12				
			FCV failure/stuck open		1.PM is performed of FCV before start up. 2.Bypass loop is available in case of FCV failure & bypass procedure will be followed. 3.FCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition 5. Flash alarm is provided at HH pressure of the reactor.	3	4	12				
			Human error(FCV bypass line passed/open)		Trained manpower is deputed for operation.	3	4	12	1.FCV bypass valve should be locked closed condition with tagging.	2	4	8
			Fast addition rate		Refer high flow safeguard							

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Failure of utility circulation in jacket of the reactor		1.Flow meter is available in chilling water supply line with low and low low alarm. 2.Chilling circulation pump running indication is available on DCS. 3.Interlock is provided to closed DMS addition line FCV in case oh HH value of TI of chilling water return line.	3	4	12				
			Human error(Steam supply line manual valve passed/left open)		1.Trained manpower is deputed for operation. 2.Double manual valve is available in steam supply line.	3	4	12	Recommend to provide blind provision in steam supply line.	2	4	8
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9	1. Flange guard to be provided on all flanges.	2	3	6

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site						Plant Name: Plant-1				
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
			Refer High/More flow									
		High	Tube bundle leakage of the reactor	No HSE hazard	1.Before startup thickness testing is performed. 2.Compatible utility is used.	3	3	9				
			Human error(mis operation)	Reactor may overflow	1. Trained manpower is deputed for operation.	3	3	9				
11	Composition	Other than	No probable cause									
		Static Electricity	-									
12	Other	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.DMS addition line FCV air failed safe position is air failed to closed condition. 4.XV of cooling water supply & return line air	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title: HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 7		Node Description: Methylation Reactor(012RT-012)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					failed are position is air failed to closed condition. 5.XV of chilling water supply & return line air failed safe position is to be air failed to open condition. 6.Utility supply line FCV air failed safe position is to be air failed to open condition.							
		Power Failure	GEB power failure	No HSE hazard/Process Delay	DG is available for power backup.	2	1	2				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.DMS addition line FCV is closed in case of agitator stop/trip.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Reaction mass transfer to Debutylation reactor(011RT-013) from methylation reactor(012RT-012)										
1	Quantity/Flow	No/Less	Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	1	3				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				
			Flame arrestor chocked in vent line methylation reactor	Reactor may imlode	1.PT available in reactor. 2.Flame arrestor PM is performed before start up. 3.Reactor is design for full vacuum.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Low level in methylation reactor	No HSE hazard/Process Delay								
			Line chocked	No HSE hazard/Process Delay								
			Human error(Vent line valve closed of Debutylation reactor)	Reactor may pressurise	1.Trained manpower will perform transferring activity and ensure vent is open before start up. 2.PT available in reactor with high and high high alarm. 3.Reactor design pressure is up to 6 bar. 4.Flash alarm is provided on HH value of PT of Debutylation reactor.	3	4	12				
		High/More	No credible cause									
		Reverse	No credible cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8	Node Description : Debutylation Reactor(GLR)(011RT-013)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Vent line valve closed of debutylation reactor)	Reactor may pressurise	1.Trained manpower will perform transferring activity and ensure vent is open before start up. 2.PT available in reactor with high and high high alarm. 3.Reactor design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of debutylation reactor.	3	4	12				
3	Temperature	Low	No credible cause									
		High	No credible cause									
4	Level	Low	Refer low Flow									
		High	Human error(mis operation)	Reactor may overflow	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	3	9				
5	Composition	Other than	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
6	Others	Static charge	-	Fire hazard	1. Double earthing is provided in the reactor. 2. Before start-up earthing testing is performed. 3.Earthing jumpers is provided in the transferring line.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	1	2				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		75% H2SO4 addition in debutylation reactor(011RT-013)										

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
7	Quantity/Flow	No/Less	Human error (Bottom manual valve of 75%H2SO4 tank is not opened).	No HSE hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in day tank for monitoring the level of material. 3.Flow meter is available in transferring line . 4.Line pressure testing is done before start-up. 5. Flange guard is provided on all flanges. 6.Compatible gasket is used.	3	3	9				
			Human error (manual valve of oleum receiving line of reaction reactor not opened).	Line may pressurise Health hazard due to spillage								
			Transferring pump 041TP-283 trip/stops	No HSE hazard/Process Delay	1. Pump running indication is available on DCS.	3	1	3				
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up.	3	3	9				
			Human error (Vent line valve is not opened in 75%H2SO4 tank)	Tank of 75%H2SO4 may implode	1. Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8	Node Description : Debutylation Reactor(GLR)(011RT-013)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Low level in 041ST-139 tank	No HSE hazard	1. LI is available in the tank with low and low low alarms. 2.Flow meter is available in addition line .	3	1	3				
			Drain valve open/pass	Health hazard due to spillage	1.Blind is provided to all drain point open end flanges.	3	3	9				
			Human error (Circulation line valve open/pass)	No HSE hazard/Process Delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				
			Flow meter malfunctionin g/chocked	No HSE hazard/Process Delay	1. LI is available in the tank. 2.Flow meter PM to be performed before start the operation.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. TI is available in the reactor with high and high high alarms. 3. Cooling & chilling water supply provision is available in jacket of the reactor to control temperature. 4. Upper limit of the flow	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					meter & totaliser is freezed. 5. Flash alarm is provided at HH temperature of reactor TI. 6. Interlock is provided to stop addition pump & XV at HH temperature of reactor. XV to be closed after 20sec of pump stop. 7. Interlock is provided to stop transferring pump & XV at set value of totalser.							
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation. 2.Loadcell is available in day tank.	3	4	12				
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard	2	3	6	NRV to be provided in pump discharge line.	1	3	3
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error (Vent line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the reactor. 4. interlock is provided to stop H2SO4 addition pump & addition line XV at high high alarm of PT. 5.Flash alarm is provided on HH value of PT of the reactor.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.N2 line maximum pressure is 3kg/cm2 which is higher than reactor design pressure. 4.Double valve to be provided in N2 supply line.	3	4	12				
			H2SO4		Refer high flow safeguard							

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			addition rate fast									
9	Temperature	Low	Cooling/chilling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			Fast addition rate		Refer high flow safeguard							
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				
			Human error(more stroke set in metering pump)		1.Trained manpower is deputed for operation. 2.Flow meter is available in addition line with high and high high alarm.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in jacket		1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation. 3.interlock is provided to stop H2SO4 addition pump & closed XV at HH value of TI of chilling return line.	3	4	12				
10	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material	Before startup spark test & thickness testing is performed.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
				incompatible hazard may possible								
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.XV of 75%H2SO4 addition line air failed safe position to be air fail to close. 4. interlock is provided to stop H2SO4 addition pump, when XV closed.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.Steam TCV is closed in case of agitator stop/trip. 2.H2SO4 addition purrp is stop & XV to be closed in case of agitator stop/trip.	3	4	12				
Stream-3		Solvent recovery in Debutylation reactor under vacuum(011RT-013)										
13	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
14	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to closed the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to closed steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High Vacuum	No probable cause	No HSE hazard								
		Low	No probable cause	No HSE hazard								
15	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to closed the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to closed steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					at HH temperature and HH pressure of the reactor.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error (TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctionin g of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	12				
			Utility failure in condenser		1.TI is provided in cooling/chilling/brine supply & return line with alarms. 2.Flow meter is provided in cooling water supply line with low and low low	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					alarms. 3. interlock is provided to closed steam TCV at low low value of flow meter in PHE.							
16	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Fire extinguisher and fire hydrant point is available in near by area.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Utility is compatible with material.	3	3	9				
			Human error(mis operation)	Reactor may overflow	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe position is air fail to close. 5.ROV of vacuum line air fail safe position is air fail to open.	3	4	12				
		Power	GEB power		Two numbers of DG is	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Failure	failure		available for power backup.							
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in the reactor	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				
Stream-4		Collection in top acidic toluene receiver (011TK-343)										
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in nearby area. 6.All electrical equipment are flameproof in nearby area.	3	3	9				
			Human Error (Manual valve of	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position	4	1	4				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			material collection line on receiver is not open|		before startup.							
			No/low level in distillation column	No HSE hazard/Process Delay								
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.Interlock is provide that at LL value of flow meter in	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					cooling water supply line in PHE steam TCV to be closed. 8.At HH temperature of final vent line steam TCV is closed. 9.Flash alarm is provided on HH value of TI of final vent line.							
			Human error(Heating stopped)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.Steam TCV indication is available on DCS.	3	2	6				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line . 4.Compatible utility is used in condenser .so, there are no chances of incompatibility hazard. 5.Flash alarm is provided on high high value of LI of receiver.	3	3	9				
			Human error (Steam TCV	Temperature rise may	1.Trained manpower is deputed for operation.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			more percentage open)	possible in the reactor	2.2 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error (Manual vacuum balancing line valve is not opened)	Receiver may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available in receiver with HH alarms. 3.Receiver design pressure is up to 6 bar. 4. Flash alarm is provided at HH pressure of receiver.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
21	Temperature	Low	No probable cause									
		High	Refer High/More flow									
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver . 4.Fire hydrant points& fire extinguisher are available in near by area. 5.All electrical equipment are flameproof in nearby area.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static	-	Fire hazard	1. Double earthing is	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Electricity			provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-5		Process water/RO water charging in debutylation reactor (GLR) (011RT-013)										
25	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard	1.Trained manpower is deputed for operation. 2. Flowmeter is available in the line to ensure flow.	2	2	4				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms.	3	4	12				
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Trained manpower is deputed for operation. 2.Upper limit of totaliser is freeze as per process requirement. 3.Interlock is provided to closed the water transferring line ROV at set value achieved in totaliser.	3	2	6				
			Flow meter malfunction		1.Flow meter PM is performed as per predefined schedule.	3	2	6				
		Reverse	No probable cause									
		Mis-directed	No credible cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		flow										
26	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpower is deputed for operation and ensure proper lineup before startup. 2. PT is available in the reactor with high and high high alarm. 3. Interlock is provided to closed water transferring line ROV at HH pressure of the reactor. 4. Flash alarm is provided on HH value of PT of the reactor.	3	4	12				
27	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
28	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up	2	3	6				
			Line leakage		1. Line testing done before start-up.	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					2. Compatible gasket is used.							
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
			Refer High/More flow									
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Human error(mis operation)	Reactor may overflow	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.Interlock is provided to close water transferring line ROV ,when steam TCV is open.	3	3	9				
29	Composition	Other than	No probable cause	No HSE hazard								
30	Others	Static Electricity	-	No HSE hazard								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Water transferring line ROV air failed safe position is to be air failed to closed condition.	3	1	3				
		Power Failure	-	No HSE hazard								
		DCS Failure	-	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.Agitator no load tripping is provided. 2.Water charging line ROV is closed in case of agitator stop/trip.	3	1	3				
Stream-6		Toluene charging in debutylation reactor(GLR)(011RT-013)										
31	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (receiving line on reactor valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	3	6				
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	2	1	2				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			No level in tank	No HSE hazard	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line. 3.Interlock is provide to stop the transferring pump at LL value of LI of storage tank.	3	1	3				
			Human error (Vent line of reactor valve not opened)	Reactor may pressurize	1.PT is available with high and high high alarm. 2.PG is also provided on reactor. 3.Trained manpower is deputed for operation. 4.Reactor design pressure up to 6bar. 5. interlock is provided to stop the incoming pump and same time ROV to be closed of toluene transferring line at HH value of PT of the reactor.	3	4	12				
			PVRV chocked of U/G tank	Tank may implode	1.PM of PVRV is performed as per schedule. 2.PT is provided on tank. 3.Tank is design for full vacuum.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flowmeter malfunctionin g	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	3	1	3				
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow	1.Trained manpower is deputed for DCS operation. 2.Upper limit is freezed in the totaliser to prevent more charging of toluene. 3.Interlock is provided to stop the pump at given set value achieve in totaliser.	3	3	9				
		Mis-directed flow	Human error (Wrong line up)	Line may pressurize	1. Double manual valve is available at toluene header. 2.Trained manpower is deputed for operation.	2	3	6				
32	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpower is deputed for operation and ensure proper lineup before startup. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is provided to	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					stop charging pump & ROV of transferring line to be closed at HH pressure of the reactor. 4. Flash alarm is provided at HH pressure of the reactor.							
33	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
34	Level	Low	Reactor Bottom valve left open/pass	Health hazard & fire hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Refer low flow									
		High	Refer High/More flow									
35	Composition	Other than	No probable cause									
36	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.ROV of toluene transferring line air failed safe position is air failed to closed. 4.Interlock is provided to stop the pump of Toluene transferring when ROV is closed.	2	3	6				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-7		Aqueous transferring in debutylation S-5 aqueous tank(010TK-350)										
37	Quantity/Flow	No/Less	Line leakage	No HSE hazard/Process Delay	1.Line pressure testing is performed before startup.	3	1	3				
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
38	Pressure	Low pressure in 1KL tank	Human error(Vent valve closed of 1KL HDPE tank)	Tank may implode	1.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High pressure in 6.3KL tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with high and high high alarm. 3.Flash alarm is provided on HH alarm of PT of the tank. 4.Tank design pressure is up to 6 bar pressure.	3	4	12	Vent line valve of S-5 aqueous tank should be locked open condition with tagging.	2	4	8
39	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
40	Level	Low	Aqueous tank leakage, aqueous transferring line valve pass/leakage	No HSE hazard								
		High level in 1KL tank	More aqueous charge	Overflow from tank may possible	1.Level switch is available in tank. 2.Interlock is provided to start the 1KL tank unloading pump at LSH activation and same time	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					aqueous transferring line ROV to be open.							
		High level in 6.3KL tank	More aqueous charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.LSH is also provided in tank . 2.Flash alarm is provided on HH value of LI & LSH activation of aqueous tank. 3.Interlock is provided to continuous stop the incoming pump & aqueous transferring line ROV at HH value of LI & LSH activation of aqueous tank.	3	3	9				
41	Composition	Other than	No probable cause									
		Static charge	No probable cause	No HSE hazard								
42	Others	Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Aqueous transferring line ROV air failed safe position is to be air failed to closed	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					condition. 4. interlock is provided to stop the aqueous transferring pump when transferring line ROV is closed.							
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									
Stream-8		Organic transferring in debutylation S-5 organic tank(010ST-213)(12KL)										
43	Quantity/Flow	No/Less	Line leakage	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in nearby area. 3.Line pressure test is performed before startup.	3	3	9				
		High/More	No probable cause									
		Reverse	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Mis-directed flow	No probable cause									
44	Pressure	Low pressure in 1KL tank	Human error (Vent valve closed of 1KL organic tank)	Tank may implode	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12				
		High pressure in 12KL tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with high and high high alarm. 3.Flash alarm is provided on HH value of PT of the tank. 4.Interlock is provided to continues stop the organic transferring pump & transferring line XV closed at HH value of PT of the tank. 5.PVRV is provided on tank. 6.ESH is provided on tank.	3	4	12	1.Vent line valve of 30KL organic tank should be locked open condition.	2	4	8
45	Temperature	Low	No probable cause	No HSE hazard								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	No probable cause	No HSE hazard								
46	Level	Low	Organic tank leakage, Organic transferring line valve pass/leakage	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in nearby area. 2.All electrical equipment are flameproof in nearby area.	3	3	9				
		High level in 1KL tank	More organic charge	Overflow from tank may possible	1.Level switch is available in tank. 2.Interlock is provided to start the 1KL tank unloading pump & organic transferring line XV at LSH activation.	3	3	9				
		High level in 30KL tank	More organic charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.Level switch is available in tank . 3. interlock is provided to continuous stop the incoming pump & transferring line XV at HH value of LI & LSH activation of tank. 2.Flash alarm is provided on HH value of LI of tank and also LSH activation.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
47	Composition	Other than	No probable cause									
48	Others	Static charge	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in nearby area. 4.All electrical equipment are flameproof in nearby area.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Organic transferring line ROV air failed safe position is to be air failed to closed condition. 4. interlock is provided to stop the aqueous transferring pump when transferring line ROV is closed. 5.Organic transferring line	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					XV of reactor to 1KL tank air failed safe position is to be air failed to closed condition.							
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									
Stream-9		S-5 Organic transfer from debutylation S-5 organic tank(010ST-213) to organic S-5 feed tank(040ST-137)										
49	Quantity/Flow	No/Less	Line leakage	Health hazard and fire hazard may possible due to spillage	1.Fire hydrant points& fire extinguisher are available in nearby area. 2.All electrical equipment are flameproof in nearby area. 3.Line pressure test is performed before startup.	3	3	9				
			Transferring Pump trip/stop	No HSE hazard/Process Delay	1. Pump running indication is available on DCS.	3	1	3				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	Flowmeter PM is performed before start-up.	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Drain valve open/pass	Health hazard and fire hazard may possible due to spillage	Double manual valve provision or blind is provided at drain point.	3	3	9				
		High/More	No probable cause									
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard	3	2	6	NRV to be provided in pump discharge line.			
		Mis-directed flow	No probable cause									
50	Pressure	Low pressure in 30KL tank (Debutylation organic tank)	Human error (Vent valve closed of 1KL organic tank)	Tank may implode	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with low and low low alarms. 3.Vent line valve is locked open condition with tagging. 4.Interlock is provided to stop the debutylation organic transferring pump at LL value of PT of debutylation organic tank and after 20 sec of pump	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					stop transferring line XV to be closed.							
			Flame arrestor chocked in organic 1KL tank		Flame arrestor PM is performed before startup.	3	4	12				
		High pressure in 15KL tank(S-5 organic feed tank)	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with high and high high alarm. 3.Vent line valve of 15KL S-5 feed tank is locked open condition. 4.Flash alarm is provided on HH value of PT of the S-5 feed tank. 5. interlock is provided to continues stop the organic transferring pump & transferring line XV closed after 20 sec of pump stop at HH value of PT of the feed tank. 6.ESH is provided on tank.	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					7.PVRV is provided in feed tank.							
51	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
52	Level	Low	Organic tank leakage, Organic transferring line valve pass/leakage	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in nearby area. 2.All electrical equipment are flameproof in nearby area. 3.Line pressure test is performed before startup.	3	3	9				
		High level in 15KL tank (S-5 feed tank)	More organic charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.Level switch is availsible in tank . 3.Interlock is provided to continuous stop the incoming pump & transferring line XV at HH value of LI & LSH activation of tank. 4.Flash alarm is provided on HH value of LI of tank and also LSH activation.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
53	Composition	Other than	No probable cause									
54	Others	Static charge	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in nearby area. 4.All electrical equipment are flameproof in nearby area.	3	3	9	1.Earthing jumper to be provide at flange joint.	2	3	6
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Organic transferring line ROV air failed safe position is to be air failed to closed condition. 4.Interlock is provided to stop the organic transferring pump when transferring line ROV is closed.	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 8		Node Description : Debutylation Reactor(GLR)(011RT-013)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Pure MEP distillation in 010RT-015										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					pump trip/stops. 6. Interlock is provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
		High Vacuum	No probable cause	No HSE hazard								
		Low	No probable cause	No HSE hazard								
3	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to stop the XV & CV of	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4.Spill kit is provided in the nearby area to contain spillage.	3	3	9	1. Double manual valve to be provide to prevent valve passing.	2	3	6
		High	No probable cause									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of Oil line air failed safe position is air fail to	3	4	12				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					close. 2.PCV of vacuum pot air fail safe position is air fail to close. 3.ROV of vacuum line air fail safe position is air fail to open.							
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping is provided. 2.Oil TCV is closed in case of agitator stop/trip.	3	4	12				
Stream-2		Collection of pure MEP in receiver 011TK-033										
7	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in distillation column	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2			Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE ,OI PCV to be closed. 8.At HH temperature of final vent line OI PCV is closed.							
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay								

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so, there are no chances of incompatibility hazard. 5.Flash alarm is provided on high high value of LI of receiver.	3	3	9				
			Human error(Oil PCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 2.Interlock is provided that at HH temperature of top of the column Oil PCV to be closed.	3	4	12				
		Reverse	No probable									

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms. 3. Flash alarm is provided at HH pressure of receiver.	3	3	9				
9	Temperatur e	Low	No probable cause									
		High	No probable cause									
10	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver with low and low low alarms. 4.Equipment thickness testing is carried out as per	3	3	9				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09		Node Description : 010RT-015(Pure MEP distillation reactor)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					define schedule.							
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3. Fire hydrant points& fire extinguisher are available in nearby area. 4.All electrical equipment are flameproof in nearby area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS	Battery bank	No HSE	Battery bank backup is	3	1	3				

HAZOP study of MEP project at 8203 site												
P&ID of MEP_Plant-01 STAGE_2		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-1			
Node 09	Node Description : 010RT-015(Pure MEP distillation reactor)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Failure	failure	hazard	provided and PM is done for the same periodically.							
		Agitation	Not applicable									

|| END OF THE REPORT ||

HAZOP Compliance Report						
Sr No	Node	Stream	Recommendations	Department	Status	PAGE NO
1	Grignard Addition Reactor (013RT-006)	THF charging in the grignard addition reactor (013RT-006) from THF tank(030ST-013)	Vent line valve should be locked open condition with tagging.	Mechanical	Completed	1
2	Quenching reactor(013RT-162)	Aqueous transfering in aqueous tank(010TK-349)	Vent line valve of aqueous tank should be locked open condition with tagging.	Mechanical	Completed	2
3		Water charging in quenching reactor (013RT-162)	Vent line valve should be locked open with tagging.	Mechanical	Completed	3
4	Methylation Reactor(012RT-012)	DMS addition in methylation reactor (012RT-012) from DMS day tank (2KL)	Flange guard to be provided on all flanges.	Mechanical	Completed	4
5			FCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	5
6			Recommend to provide blind provision in steam supply line.	Mechanical	Completed	6
7	Debutylation Reactor(GLR)(011RT-013)	75% H2SO4 addition in debutylation reactor(011RT-013)	NRV to be provided in pump discharge line.	Mechanical	Completed	7
8			TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	8
9		Solvent recovery in debutylation reactor under vacuum(011RT-013)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	9
10			Vent line valve of S-5 aqueous tank should be locked open condition with tagging.	Mechanical	Completed	10
11			Vent line valve of 30KL organic tank should be locked open condition.	Mechanical	Completed	11
12		S-5 Organic transfer from debutylation S-5 organic tank(010ST-213) to organic S-5 feed tank(040ST-137)	NRV to be provided in pump discharge line.	Mechanical	Completed	12
13			Earthing jumper to be provide at flange joint.	Mechanical	Completed	13
14	010RT-015(Pure MEP distillation reactor)	Pure MEP distillation in 010RT-015	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	14
15			Double manual valve to be provide to prevent valve passing.	Mechanical	Completed	15

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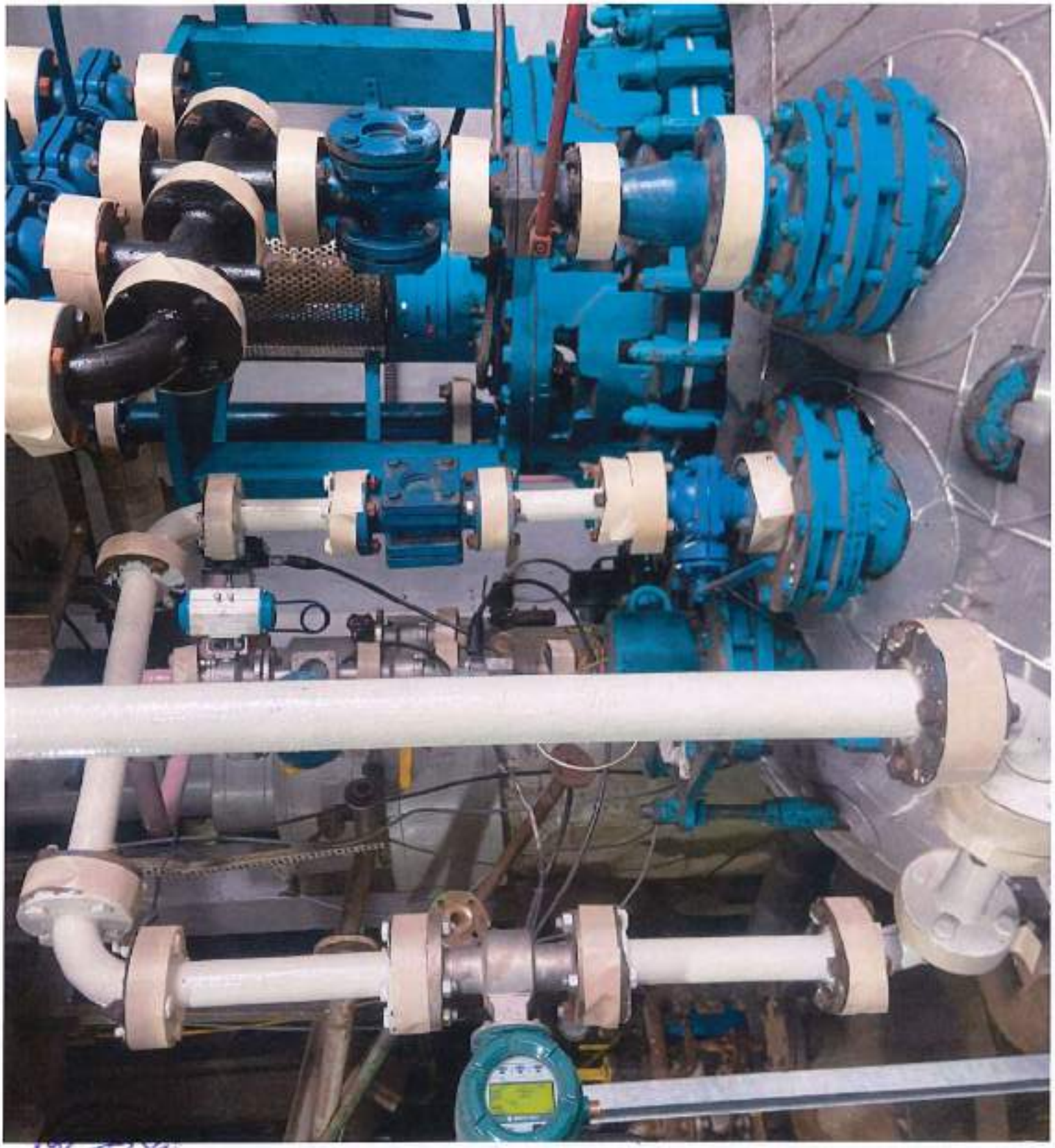
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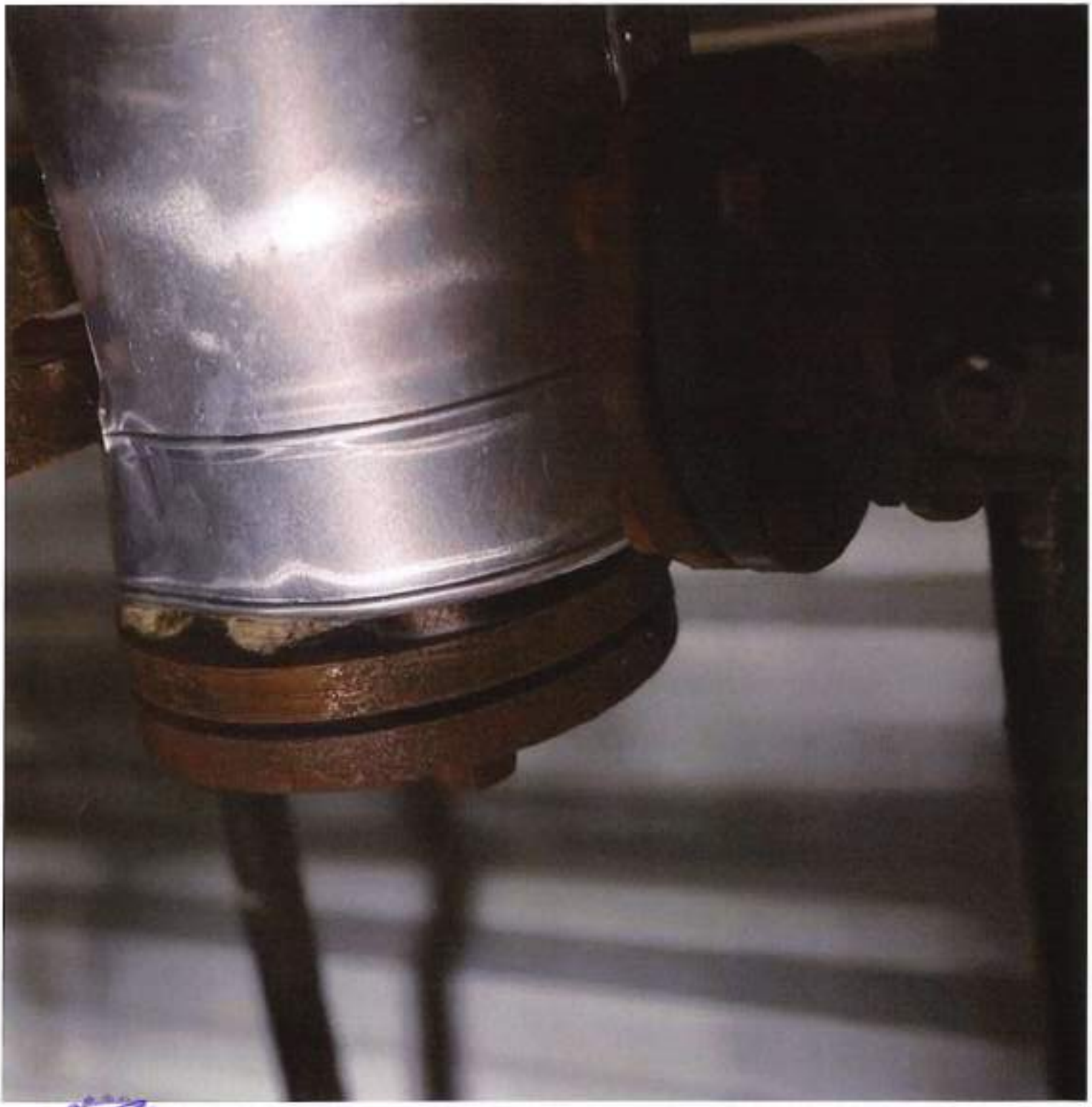


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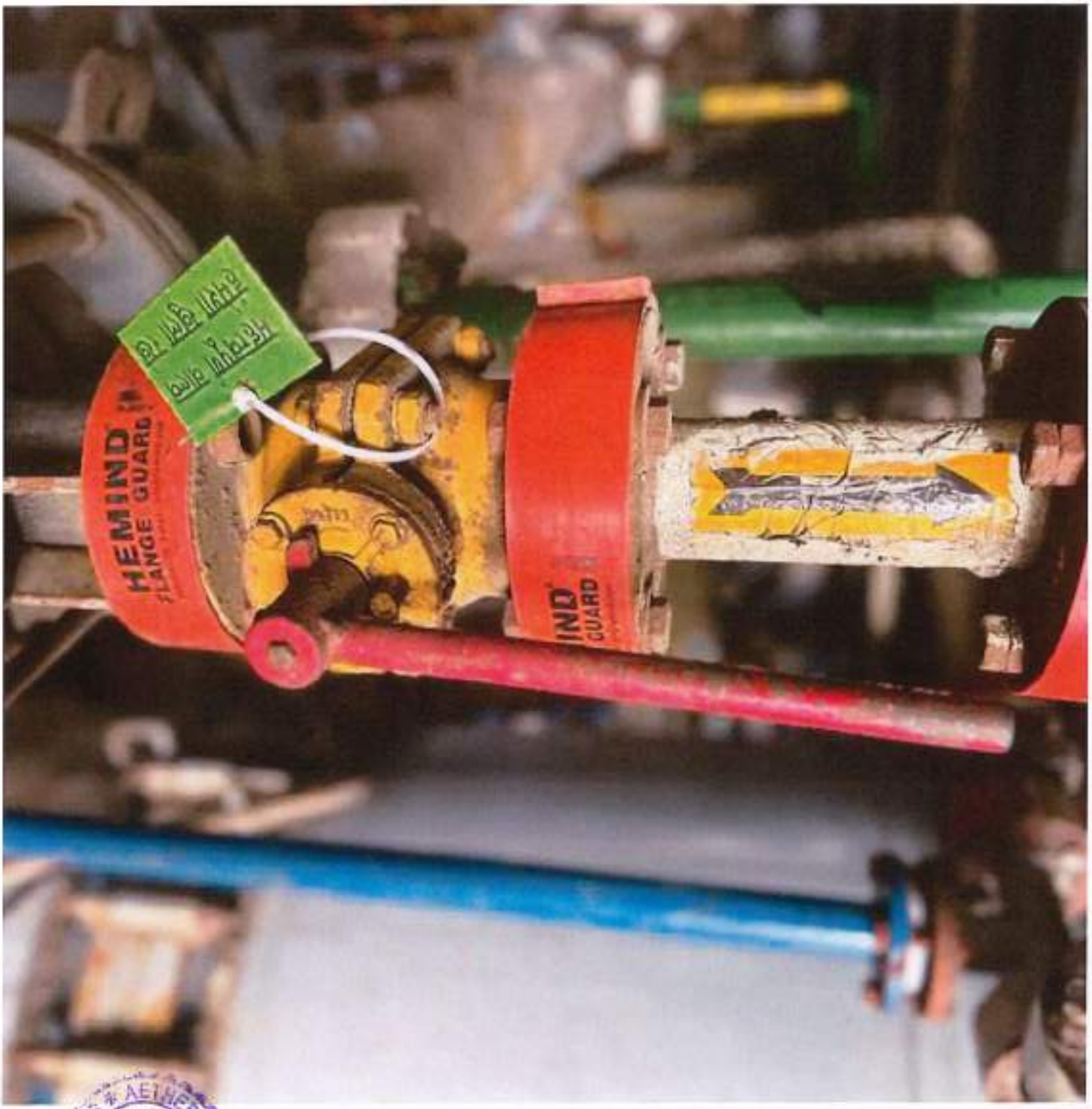








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HAZOP STUDY REPORT OF

T_2E PLANT

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

MAY 2017

aether
elementally innovative



NEXA
Process Safety Engineers

979

AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

HAZOP STUDY REPORT OF

T2E PLANT

MAY 2017

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

01/05/2017

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for T_2E Plant.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for T_2E Project.

It has 15 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	Thiophene day tank (040TK-285)
2.	H2O2 day tank (043TK-253)
3.	Halogenation reactor(043RT-110)
4.	Aqueous tank(040ST-185)
5.	Organic storage tank(040ST-152)
6.	2CT distillation reactor(041RT-106)
7.	Grignard addition reactor(043RT-083)
8.	Grignard reactor(042RT-086)
9.	EO day tank(043TK-245)
10.	EO coupling reactor(042RT-089)
11.	Coupling mass storage reactor(043RT-082)
12.	Quenching reactor(041RT-091)
13.	Continuous THF distillation column(041CM-046)
14.	Continuous Toluene distillation column (Bromo benzene distillation column)(041CM-047)
15.	T2E batch distillation column(041CM-050)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make

recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other’s ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.

3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

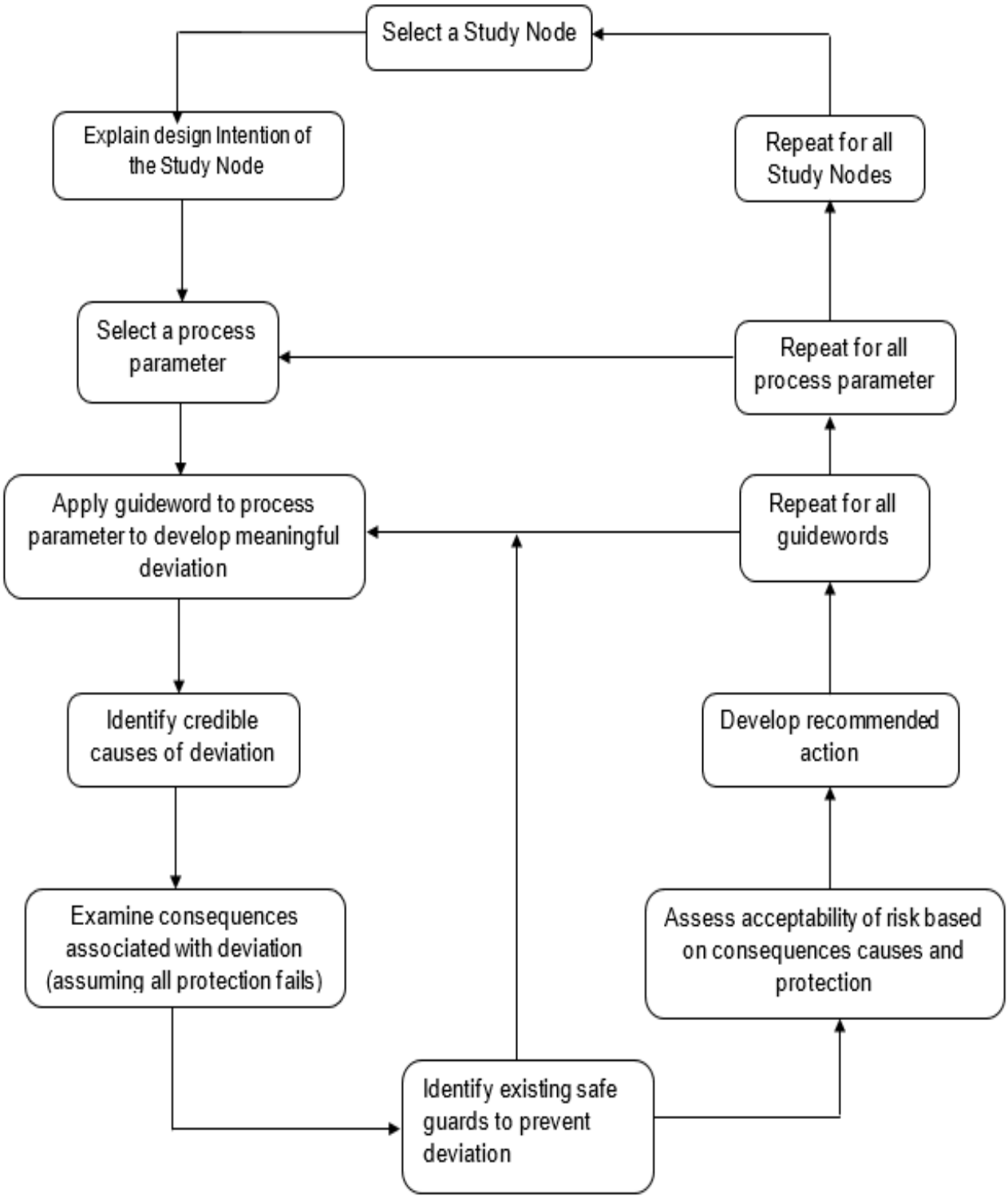
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	T2E_Plant-06

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to

the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following: -

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.

- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

"...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

T2E HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	Thiophene day tank (040TK-285)	Thiophene drum charging in day tank (040TK-285) by using vacuum	Flange guard to be provided on all flanges.	Mechanical
2	Halogenation reactor(043RT-110)	30%HCl charging in the halogenation reactor (043RT-110) from HCl tank	Recommend to freeze the upper limit of totaliser as per process requirement.	Production

T2E HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
3	Aqueous tank(040ST-185)	Aqueous transferring in aqueous tank(040ST-185) from halogenation reactor(043RT-110)	Vent line valve should be locked open condition withy tagging	Mechanical
4	Grignard reactor(042RT-086)	THF + 2CT addition in grignard reactor (042RT-086) from grignard addition reactor (043RT-083)	Vent line valve should be always locked open condition with tagging.	Mechanical
5	Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)	Continuous feeding from storage tank(40TK-229) to distillation column(041CM-047) through feeding pump(040TP-291A)	TCV bypass valve should be locked closed condition with tagging.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please

refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 15/03/2017**			
Node 1		**Node Description : Thiophene day tank (040TK-285)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**Thiophene drum charging in day tank (040TK-285) by using vacuum**										
1	Quantity/Flow	No/Less	Low vacuum/no vacuum	No HSE hazard/process delay	1.Compound type PT is available on DCS.	3	1	3				
			Human error (Discharge manual valve not opened on day tank).	No HSE hazard/process delay	1. Trained manpower will deputed for drum charging.	3	1	3				
			Hose/Flange leakage	Fire hazard& health hazard due to Spillage	1.Compatible gasket is used. 2.All electrical installation are flameproof as per HAC classification. 3. Fire extinguishers & fire hydrant points are available in nearby places.	3	3	9	1. Flange guard to be provided on all flanges.	2	3	6
			Hose pipe chocked	No HSE hazard/process delay	Material having no chocking property.	1	1	1				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 15/03/2017**			
Node 1		**Node Description : Thiophene day tank (040TK-285)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(vent line manual valve open)	No HSE hazard/process delay	1.Trained manpower is deputed for operation and ensure proper lineup before start charging.	3	1	3				
		High/More	Human error (More drums charged)	Day tank may overflow	1. Batch wise fix quantity of material is issue from the store. 2.LI is available on DCS with high and high high alarms.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No credible cause	-								
		High	No credible cause	-								
4	Level	Low	Tank body leakage	Fire hazard & health hazard due to spillage	1.Material is compatible with tank MOC. 2.Pressure testing & PM is performed	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 1		**Node Description : Thiophene day tank (040TK-285)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					before startup. 3.Fire extinguishers are available in nearby places. 4.All electrical installation are flameproof as per HAC classification.							
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				
			Tank bottom valve leakage/passed		Double manual valve is provided at bottom of the day tank.	2	3	6				
		High	Refer high flow									
5	Composition	Other than	Wrong material supply from store	Material incompatibility hazard may possible	1.Issue slip & physical verification of drum is done before start-up.	3	3	9				
6	Others	Static Electricity	-	Fire hazard	1. Earthing rod is provided in the drum while charging. 2. Dual earthing is provided in the day tank.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 15/03/2017**			
Node 1		**Node Description : Thiophene day tank (040TK-285)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 2		**Node Description : H2O2 day tank (043TK-253)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**H202 transferring in H2O2 day tank (043TK-253) from H2O2 tank**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (receiving line on day tank valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	3	9				
			Transferring pump trip/stops	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line leakage	Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 2		**Node Description : H2O2 day tank (043TK-253)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used.							
			No level in tank	No HSE hazard	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line.	2	1	2				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				
			Human error(Day tank vent line valve is closed)	Day tank may pressurise	1.Trained manpower is deputed for operation and ensure proper line up before startup. 2.Tank design pressure is up to 6 bar.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 2		**Node Description : H2O2 day tank (043TK-253)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	Day tank may overflow	1.Trained manpower is deputed for DCS operation. 2.LI is available on day tank with high and high high alarm. 4.LSH is available on day tank.	3	3	9				
		Reverse	Pump trip/stop	Pump mechanical failure	1.Recommend to provide NRV in pump discharge line.	3	2	6				
		Mis-directed flow										
2	Pressure	Low	No probable cause									
		High	Human error(Vent line valve is not open during transferring)	Day tank may pressurise	1.Trained manpower is deputed for operation and ensure proper line up before startup. 2.Tank design pressure is up to 6 bar.	3	4	12				
3	Temperature	Low	No probable cause	-	TI is available in day tank with low and low low alarm.							
		High	No probable cause	-	TI is available in day tank with high and high high alarm.							

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 2		**Node Description : H2O2 day tank (043TK-253)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Bottom valve leakage/passed	Health hazard due to spillage	SS compatible valve and metallic gasket is used.	2	3	6				
			Line/Flange leakage		Line pressure test is performed before start up.	2	3	6				
			Tank leakage		No safeguard	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-									
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due	No HSE hazard/Process Delay								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 2		**Node Description : H2O2 day tank (043TK-253)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			to mechanical failure									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Thiophene charging in the halogenation reactor(043RT-110) from thiophene day tank by pump**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve is not open of thiophene day tank).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.	3	1	3				
			Human error (manual valve of reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.. 2.Flow meter is available in transferring line. 3.Line pressure test is performed before startup. 4.Compatible gasket is used to prevent gasket leakage. 5.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6. Fire extinguishers & fire hydrant points are available in nearby places.							
			Pump trip/stop	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Compatible gasket to be used to prevent gasket leakage.	3	3	9				
			Low level in day tank	No HSE hazard/Process Delay	1.Flow meter is available in transferring line . 2.LI is available on tank to monitor the level of tank.	3	1	3				
			Line/Valve chocked	No HSE hazard/Process Delay	1.Material having no chocking property.							

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunctioning	Reactor may overflow	1.Flow meter PM is performed before start up. 2.LI is also available on day tank to monitor the level.	3	3	9				
			Human error(Reactor vent line valve is closed)	Reactor may pressurise	1.PT is available on reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6 bar.	3	4	12				
		High/More	Human error (More material charge in day tank)	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating. 2.Batch wise fixed quantity will be issued from store.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause									
		High	Human Error (During charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Reactor design pressure is 6 bar.	3	4	12				
			N2 line manual valve passed/left open		1.PRV is available in N2 line. 2.N2 line maximum pressure is 3kg/cm2. 4.Reactor design pressure is 6 bar.	3	4	12				
			Flame arrestor chocked in catch pot		Flame arrestor PM is performed as per predefine schedule.	3	4	12				
3	Temperature	Low	No probable cause									
		High	No probable cause	No HSE hazard/Process Delay	TI is available in reactor with high and high high alarm.	2	1	2				
4	Level	Low	Refer low flow									
		High	Refer high flow									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	Transferring line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-2		**30%HCl charging in the halogenation reactor (043RT-110) from HCl tank**										
7	Quantity/Flow	No/Less	Human error (Tank bottom valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up. 4.LI is available on tank to monitor the level of tank.	2	1	2				
			Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.150 class flange is used.	3	3	9				
			No level in tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available on	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					tank to monitor the level of tank.							
			Human error (Vent line valve not opened)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Reactor design pressure is 6 bar.	3	4	12				
		High/More	Human error (Wrong input in totaliser)	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating.	3	3	9	1.Recommend to freez the upper limit of totaliser as per process requirement.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow										
8	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human Error (During charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Reactor design pressure is 6 bar.	3	4	12				
			N2 line manual valve passed/left open		1.PRV is available in N2 line. 2.N2 line maximum pressure is 3kg/cm2. 4.Reactor design pressure is 6 bar.	3	4	12				
			Flame arrestor chocked in catch pot		Flame arrestor PM is performed as per predefine schdule.	3	4	12				
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Human error(Sequence change of material charging)	Temperature rise may possible in reactor	TI is available in reactor with high and high high alarm.	2	4	8				
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-									
		Instrument Air failure	Air compressor failure	Transferring line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due	Temperature rise may	1.No load tripping is provided on agitator.	2	4	8				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			to mechanical failure	possible in reactor	2.VFD is provided in motor of the agitator.							
Stream-3		**Catalyst charging into halogenation reactor(043RT-110)**										
13	Quantity/Flow	No/Less	Human Error(Less Quantity charged)	No HSE hazard	1.Fixed quantity of material will be issued from the store batchwise. 2.Weigh balance calibration is doing at every day.	2	1	2	.			
			Wrong measured quantity supplied from store department	No HSE hazard	Issue slip & physical verification of quantity is done before start-up.	2	1	2				
			Human Error (Spillage)	No HSE hazard	1. Full body air supply suit is wear by person during charging. 2. Trained manpower will be deputed for this activity. 3. Hopper with valve will be used for charging.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human Error(More Quantity charged)	Temperature rise may possible in reactor	1. Fixed quantity of material will be issued from the store batchwise. 2. Issue slip & physical verification of quantity is done before start-up. 3. Trained manpower will performed the activity. 4.TI is available in reactor with high and high high alarm.	3	3	9				
			Wrong measured quantity supplied from store department									
			Human error(more percentage of manual valve is open/valve passed)		1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Addition line size is 1/2 inch. 3.Double manual valve is provided in addition line.	3	3	9				
		Reverse	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
14	Pressure	Low	Not Applicable									
		High	Not Applicable									
15	Temperatu re	Low	Not Applicable									
		High	Not Applicable									
16	Level	Low	Not Applicable									
		High	Not Applicable									
17	Compositio n	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1.Material is verified by production supervisor with material code.and mentioned in checklist.	3	3	9				
18	Other	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed while charging in the reactor. 2. Earthing continuity is ensured before start-up. 4. Suitable PPE's are available. (Goggles, Face shield, Hand gloves, Dust Mask)	3	3	9				
		Instrument Air failure	Not Applicable	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	Not Applicable	No HSE hazard								
		DCS Failure	Not Applicable	No HSE hazard								
		Agitation	Not Applicable									
Stream-4		**H2O2 addition & maintaining in halogenation reactor (043RT-110) from H2O2 day tank(043TK-253)**										
19	Quantity/Flow	No/Less	Human error (Bottom manual valve of H2O2 day tank is not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in addition line 3.LI is available in H2O2 day tank to monitor the level of day tank.	3	1	3				
			Human error (manual valve on halogenation reactor not opened).									
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket issued.	3	3	9				
			Low level in H2O2 day tank	No HSE hazard/Process Delay	1.Flow meter is available in addition line 2.LI is available in H2O2 day tank to	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					monitor the level of day tank.							
			Flow meter malfunctioning/chocked	No HSE hazard/Process Delay	1.Flow meter PM to be performed before start the operation.	3	1	3				
			Human error(vent line valve not opened of halogenation reactor)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.PT is available on reactor with high and high high alarm. 3.Reactor design pressure is upto 6 bar.	3	4	12				
			Human error(vent line valve not opened of H2O2 day tank)	Day tank may implode	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Tank is design for full vacuum.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. TI is available in the reactor with high and high high alarms. 3. Cooling water & brine provision is available in jacket of the reactor to control temperature.	3	4	12				
			Human error(Another material charging line ROV open)		1. Trained manpower is deputed for operation. 2. TI is available in the reactor with high and high high alarms. 3. Cooling water & brine provision is available in jacket of the reactor to control temperature.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error (Vent line of halogenation reactor valve not opened) during addition	Reactor may pressurise	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the reactor with HH alarms. 3.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Double valve is provided in N2 supply line.	3	4	12				
			Flame arrestor chocked of catch pot		1.PM of flame arrestor is performed before startup. 2.Material having no chocking property.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Fast addition rate		Refer high flow safeguard	3	4	12				
21	Temperature	Low	No probable cause									
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation.	3	4	12				
			FCV failure/stuck open		1.PM is performed of FCV before start up. 2.Bypass loop is available in case of FCV failure bypass procedure will be followed. 3.FCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				
			Human error(FCV bypass line passed/open)		1.FCV bypass valve should be locked closed condition with tagging.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Fast addition rate		Refer high flow safeguard	3	4	12				
			Utility failure in jacket		1.TI is available in the utility supply and return line of the reactor. 2.PT is available in utility supply line. 3.Flow meter is available in utility supply line	3	4	12				
			Circulation pump for condenser to reactor trip/stop		1.Pump running indication is available on DCS.	3	4	12				
22	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9				
			Reactor body leakage		PM is performed before start-up and record is maintained.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer High/More flow	Reactor may overflow								
			Jacket puncture of the reactor		1.Before startup thickness testing is performed. 2.Compatible utility is used.	3	3	9				
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	4	8				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.VFD is provided in motor of the agitator.	2	4	8				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-5		**Water charging in halogenation reactor (043RT-110)**										
25	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow.	2	1	2				
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	1	3				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpoweris deputed for operation and ensure proper line up before startup. 2. PT is available in the reactor with alarms.	3	4	12				
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	1	3				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard/Process Delay	1.Trained manpower deputed for DCS operating.	3	1	3				
			Flow meter malfunction		1.Flow meter PM is performed as per predefined schedule.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
26	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpoweris deputed for operation and ensure proper line up before startup. 2. PT is available in the reactor with high and high high alarm.	3	4	12				
			Flame arrestor chocked in catch pot		PM of flame arrestor is performed as per predefine schdule.	3	4	12				
27	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
28	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	1. Trained manpower is deputed for operation and ensure proper line up before startup. 2.Double manual valve is available at	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					bottom of the reactor.							
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	2	3	6				
29	Compositio n	Other than	No probable cause	No HSE hazard								
30	Others	Static Electricity	-	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 15/03/2017**			
Node 3		**Node Description : Halogenation reactor(043RT-110)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	1	2				
		Power Failure	-	No HSE hazard								
		DCS Failure	-	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in reactor	1.No load tripping is provided on agitator. 2.VFD is provided in motor of the agitator.	2	4	8				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date-16/03/2017**			
Node 4		**Node Description : Aqueous tank(040ST-185)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Aqueous transferring in aqueous tank(040ST-185) from halogenation reactor(043RT-110)**										
1	Quantity/Flow	No/Less	Line leakage	No HSE hazard/Process Delay	1.Line pressure testing is done before start-up. 2.Compatible gasket issued.	2	1	2				
			Human error (manual valve on aqueous tank is not opened)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	1	3				
		High/More	Human error (withdrawal/tank is not unload at particular time interval)	Tank may overflow	1.Trained manpower is deputed for operation. 2.LI is available in tank with high and high high alarm.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low pressure in Halogenation reactor	Human error (Vent valve closed of reactor)	Reactor may implode	1.PT is available in reactor with llow and low low alarm. 2.Reactor is design for full vacuum.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date-16/03/2017**			
Node 4		**Node Description : Aqueous tank(040ST-185)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High pressure in aqueous tank	Human error(Vent line valve closed)	Tank may pressurise	No existing safeguard	3	4	12	Vent line valve should be locked open condition withy tagging	2	4	8
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Aqueous tank leakage, aqueous transferring line valve pass/leakage	No HSE hazard								
		High	Refer high flow									
5	Composition	Other than										
6	Others	Static charge	No probable cause	No HSE hazard								
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	1	2				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date-16/03/2017**			
Node 4		**Node Description : Aqueous tank(040ST-185)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 5		**Node Description : Organic storage tank(040ST-152)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Organic transferring in organic S-1 tank(040ST-152)**										
1	Quantity/Flow	No/Less	Line leakage	Health hazard and fire hazard may possible	1.Line pressure testing is performed before startup. 2. Compatible gasket is used. 3. All electrical equipment are flameproof in nearby area. 4. Fire extinguishers & fire hydrant points are available in nearby places.	3	3	9				
			Human error (manual valve on organic tank is not opened)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	1	3				
		High/More	Human error (withdrawal/tank is not unload at	Tank may overflow	1.Trained manpower is deputed for operation.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 5		**Node Description : Organic storage tank(040ST-152)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			particular time interval)		2.LI is available in tank with high and high high alarm.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low pressure in halogenation reactor	Human errror(Vent valve closed of reactor)	Reactor may implode	1.PT is available in reactor with llow and low low alarm. 2.Reactor is design for full vacuum.	3	4	12				
		High pressure in organic S-1 tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard		3	1	3				
		High	No probable cause	No HSE hazard				0				
4	Level	Low	Organic tank leakage, Organic transfering line	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in near by area.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 5		**Node Description : Organic storage tank(040ST-152)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			valve pass/leakage		2.All electrical equipment are flameproof in near by area.							
		High	Refer high flow									
5	Composition	Other than										
6	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	1	2				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 16/03/2017**			
Node 5		**Node Description : Organic storage tank(040ST-152)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Stage-1 organic transfer to 2CT distillation reactor(041RT-106)**										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	1	3				
			Drain valve pass/opened	Spillage may lead to health hazard &	No existing safeguard	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				chemical exposure.								
			Storage tank vent valve closed(Stage-1 organic)	Tank may implode	2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
			Low level in storage tank	No HSE hazard/Process Delay	1.LI is available in tank.	2	1	2				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup. 2.Material having no chocking property	3	3	9				
		High/More	Human error(more quantity of material is charged in reactor)	Reactor may overflow and chances of spillage/leakage	1.Trained manpower is deputed for DCS operation. 2.No open vent on reactor so no chances of overflow.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical damage	NRV to be provide in the pump discharge line to	3	2	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					prevent reverse flow.							
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Flame arrestor chocked in 2CT distillation reactor	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Flame arrestor PM is performed before start up.	3	4	12				
3	Temperature	Low	No credible cause									
		High	No credible cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3. Before start-up earthing testing is performed.							
		Instrument Air failure	Air compressor failure									
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream -2		**Distillation in 2CT distillation reactor(041RT-106)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Flame arrestor chocked in 2CT distillation reactor	Reactor may pressurize	1. PT is available in the reactor with High and High High alarms. 2.Flame arrestor PM is performed as per predefine schedule.	3	4	12				
			Nitrogen supply line manual valve pass/opened		1. N2 line maximum pressure is 3kg/cm2. 3. Reactor design pressure is 6 bar.	2	4	8				
			Utility failure in condenser		1.TI is provided in utility supply line of primary and secondary condenser. 2.Cooling water & chilling water circulation pump is available on DCS.	3	4	12				
			Human error(high heating rate or steam TCV open in more percentage)		1.Trained manpower is deputed for DCS operation.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Packing chocked in column		1.PT is available in reactor & top of the column with high and high high alarm. 2.Packing MOC is suitable to reaction mass.	3	4	12				
9	Temperatu re	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard	TI is available in reactor with alarms.	2	1	2				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in the reactor	1. CWS supply provision is available to reactor. 2. Leakage test is performed before start-up and documented. 3. Compound PT is available on the reactor. 4. TI is available in the reactor with high and high high alarms. 5.PM is performed of TCV before start up. 6.Bypass loop is available in case of TCV failure bypass procedure will be followed. 7.TCV indication is available on DCS with percentage. 8.PM of TCV is performed before start operation.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instruments is performed as per pre-defined schedule.	3	4	12				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up & documented. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided in the reactor bottom.	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture of the reactor	Reactor may overflow and chances of spillage/leakage	1. Before startup PM & thickness testing is performed which is documented. 2. Reaction mass is compatible with utility media. 3. Vent is connected to vent pot so overflow not possible.	2	3	6				
11	Compositio n	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up and documented. 3.Earthing jumper is provided in flange joint of solvent transferring line	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 6		**Node Description : 2CT distillation reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard	DG backup is provided to all critical equipment's.	3	3	9				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**2CT charging in the grignard addition reactor(043RT-083)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of 2CT storage tank is not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.	3	1	3				
			Human error (manual valve of reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line. 3.Line pressure test is performed before startup. 4.Compatible gasket is used to prevent gasket leakage. 5.All electrical installation are flameproof as per HAC classification. 6. Fire extinguishers	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					& fire hydrant points are available in nearby places.							
			Pump trip/stop	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Compatible gasket to be used to prevent gasket leakage.	3	3	9				
			Low level in storage tank	No HSE hazard/Process Delay	1.Flow meter is available in transferring line . 2.LI is available on tank to monitor the level of tank.	3	1	3				
			Line/Valve chocked	No HSE hazard/Process Delay	1.Material having no chocking property.							
			Flow meter malfunctioning	Reactor may overflow	1.Flow meter PM is performed before start up. 2.LI is also available	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					on BPCP storage tank to monitor the level.							
			Human error(Reactor vent line valve is closed)	Reactor may pressurise	1.PT is available on reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6 bar.	3	4	12				
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low pressure in reactor	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human Error (During charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12				
			N2 line manual valve passed/left open		1.PRV is available in N2 line. 2.N2 line maximum pressure is 3kg/cm2. 4.Reactor design pressure is 6 bar.	3	4	12				
3	Temperature	Low	No probable cause									
		High	Human error(steam TCV opened)	Temperature rise may possible in reactor	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.TI is available in	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					reactor with high and high high alarm. 3.Steam TCV indication is available on DCS.							
			Human error(steam TCV bypass line valve opened)		1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.TI is available in reactor with high and high high alarm. 3.Steam TCV bypass line valve should be always in locked closed condition with tagging.	3	4	12				
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up.							
		Instrument Air failure	Air compressor failure	Transferring line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**THF charging in the grignard addition reactor (043RT-083) from THF tank(040ST-179)**										
7	Quantity/Flow	No/Less	Human error (Tank bottom valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.LI is available on tank to monitor the level of tank.							
			Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					flameproof in near by area.							
			No level in tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available on tank to monitor the level of tank.	3	1	3				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					charging into the reactor. 4. Reactor design pressure is 6 bar.							
		High/More	Human error (Wrong input in totaliser)	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating. 2.LI is available on THF storage tank to monitor the level of tank.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	Human error(MEP grignard reactor THF charging line ROV open)	Reactor may overflow	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.ROV is provided in MEP & T2E grignard THF charging line.	3	3	9				
20	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human Error (During charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12				
			N2 line manual valve passed/left open		1.PRV is available in N2 line. 2.N2 line maximum pressure is 3kg/cm2. 4.Reactor design pressure is 6 bar.	3	4	12				
21	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
22	Level	Low	Reactor Bottom valve left open/pass	Health & Fire hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
23	Compositio n	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 16/03/2017**			
Node 7		**Node Description : Grignard addition reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	Transferring line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Not Applicable	No HSE hazard/Process Delay								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Mg turnings charging into grignard reactor(042RT-086)**										
1	Quantity/Flow	No/Less	Human Error(Less Quantity charged)	No HSE hazard	1.Fixed quantity of material will be issued from the store batchwise. 2.Weigh balance calibration is doing at every day.	2	2	4				
			Wrong measured quantity supplied from store department	No HSE hazard	Issue slip & physical verification of quantity is done before start-up.	2	2	4				
			Human Error (Spillage)	No HSE hazard	1. Full body air supply suit is wear by person during charging. 2. Trained manpower will be deputed for this activity. 3. Hopper with valve will be used for charging.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human Error(More Quantity charged)	Temperature rise may possible in reactor	1. Fixed quantity of material will be issued from the store batchwise. 2. Issue slip & physical verification of quantity is done before start-up.and mentioned inn checklist. 3. Trained manpower will performed the activity.	3	3	9				
			Wrong measured quantity supplied from store department									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	Not Applicable									
		High	Not Applicable									
3	Temperature	Low	Not Applicable									
		High	Utility failure in jacket of the reactor	Temperature rise may possible in reactor	1.TI is available in the utility supply and return line of the reactor. 2.Cooling waer circulation pump indication is available on DCS.							

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Not Applicable									
		High	Not Applicable									
5	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1.Material is verified by production supervisor with material code.							
6	Other	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed while charging in the reactor. 2. Double earthing is provided in the reactor. 3. Earthing continuity is ensured before start-up. 4. Suitable PPE's are available. (Goggles, Face shield, Hand gloves, Dust Mask) 5.Hopper is availble for charging. 6.Earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Not Applicable	No HSE hazard								
		Power Failure	Not Applicable	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Not Applicable	No HSE hazard								
		Agitation	Not Applicable									
Stream-2		**Heating in grignard reactor (042RT-086)**										
7	Quantity/Flow	No/Less	No probable cause	-	-				-			
		High/More	No probable cause	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
8	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Ventline is provided in reactor & ensure before startup that valve is open condition.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.RD is available in the reactor which is connected to catch pot. 6.PT is available in reactor with high and high high alarm. 7.Manual valve is available in line of TCV.							
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12				
			Human error(Manual ventline/vapour line valve is not open of reactor)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high and high high alarm in reactor.							
			Flame arrestor chocked in catch pot		1.PT is available with high and high high alarm in reactor. 2.Flame arrestor PM is performed as per PM schedule.							
9	Temperature	Low	Human error(cooling water supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation. 2.ROV is available in cooling supply and return line of jacket of reactor.	3	1	3				
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.RTD is available in reactor with high and high high alarm.							
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 2.Trained manpower is deputed for DCS operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of RTD is performed before startup. 3.Dual RTD is available in reactor.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	No probable cause									
		High	Jacket puncture of the reactor	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of jacket is performed periodically.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in reactor	1.Steam TCV to be closed in case of agitator stop/trip. 2.No load tripping to be provide on agitator.	3	4	12				
Stream-3		**THF + 2CT addition in grignard reactor (042RT-086) from grignard addition reactor (043RT-083)**										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of grignard addition reactor valve not opened). Human error (manual valve of grignard reactor not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	2	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Fire extinguisher and fire hydrant point is provided in near by area. 3.Compatible gasket issued. 4.All electrical installation as per HAC 4lassification.	3	3	9				
			Low level in grignard addition reactor	No HSE hazard/Process Delay	Flow meter is available in addition line .	3	2	6				
			Flow meter malfunctioning /chocked	Process delay	1.Flow meter PM to be performed before start the operation.	3	2	6				
			Human error(vent line valve not opened of grignard reactor)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.PT is available on reactor with high and high high alarm. 3.Reactor design	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pressure is up to 6 bar.							
			Human error(vent line valve not opened of grignard addition reactor)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.	3	2	6	1.Vent line valve should be always locked open condition with tagging.	2	2	4
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. TI is available in the reactor with high and high high alarms. 3. Cooling water provision is available in jacket of the reactor to control temperature.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Addition line FCV stuck		PM of FCV is performed as per schedule.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Vent line of grignard reactor valve not opened) during addition	Reactor may pressurise	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the reactor with HH alarms.	3	4	12				
			Human error (Vent line of grignard catch pot valve not opened) during addition		1. catch pot is designed pressure to 6 bar pressure.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Double valve is	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					provided in N2 supply line.							
			Flame arrestor chocked		1.PM of flame arrestor is performed before startup. 2.Material having no chocking property.	3	4	12				
			Utility failure in condenser of reactor		1.TI is available in utility supply & return line of the condenser. 2.Flow meter is available in cooling water supply line.	3	4	12				
			TCV passed		PM of TCV is performed before start up.	3	4	12				
			Human error(steam bypass valve passed/left open)		Trained manpower is deputed for operation.	3	4	12				
			Fast addition rate		Refer high flow safeguard	3	4	12				
			Jacket puncture of the reactor		1.PM is performed as per schedule.	3	4	12				
			Tube leakage in condenser		No existing safeguard	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
15	Temperature	Low	Cooling/Chilling water supply valve opened/passed	No HSE hazard								
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation. 3.Dual RTD is provided on reactor.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm. 5.Manual valve	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					available in line of TCV.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			Fast addition rate		1.Flowmeter & totaliser is available in the addition line.	3	4	12				
			Jacket puncture of the reactor		1.PM is performed as per schedule.	3	4	12				
			Tube leakage in condenser		No existing safeguard	3	4	12				
16	Level	Low	Reactor Bottom valve left open/pass	health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Exotherm may possible in the reactor	1.PM is performed as per schedule.	3	4	12				
			Tube leakage in condenser		No existing safeguard	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 8		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.VFD is provided in motor of the agitator.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 9		**Node Description : EO day tank(043TK-245)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**EO transferring in EO day tank (043TK-245) from EO tank**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (receiving line on Day tank valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	3	6				
			Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank with low and low low alarms.	2	2	4				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 9		**Node Description : EO day tank(043TK-245)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.							
			No level in tank	No HSE hazard/Process Delay	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line.	2	1	2				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				
		High/More	Human error (Wrong input in totaliser)	Day tank may overflow	1.Trained manpower is deputed for DCS operation. 2.Day tank vent is	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 9		**Node Description : EO day tank(043TK-245)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					given in dumped tank. 3.Loadcell is available on day tank with high and high high alarm. 4.LSH is available on day tank.							
		Reverse										
		Mis-directed flow	Human error(Wrong line up)	Line may pressurize	1. Double manual valve is available at EO header. 2.Trained manpower is deputed for operation.	3	4	12				
2	Pressure	Low	No probable cause									
		High	N2 line manual valve passed/left open	Day tank may pressurise	1.Double manual valve is provided in N2 line. 2.Tank design pressure is up to 6 bar. 3.PRV is available in main nitrogen line. 4.Pressure transmitter is available with high and high high alarm.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 9		**Node Description : EO day tank(043TK-245)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.PSV is available on day tank.							
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Chilling circulation failure due to chiling plant issue	Tank may pressurise due to temperature rise in day tank	1.TI is available on day tank with high and high alarm. 2.TI is available in chilling water return line with high high alarm. 3.Chilling plant pump trip/stop indication is available on DCS with alarm.	3	4	12				
4	Level	Low	Loadcell malfunction	No HSE hazard/Process Delay	PM of loadcell is performed before startup.	2	3	6				
			Bottom valve leakage/passed	Health hazard & fire hazard due to spillage	SS compatible valve and metallic gasket is used. 2.Double manual valve is provided on bottom of the tank.	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 9		**Node Description : EO day tank(043TK-245)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage		Line pressure test is performed before start up.	2	3	6				
			Tank body leakage		1.Tank MOC is compatible with material.	2	3	6				
		High	Refer High/More flow									
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard/Proces s Delay								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 9		**Node Description : EO day tank(043TK-245)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Toluene charging in EO coupling reactor (042RT-089)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (receiving line on reactor valve not opened).	Line may pressurize and lead to fire & health hazard	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	3	9				
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.							
			No level in tank	No HSE hazard	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line.	2	1	2				
			Human error (Vent line of reactor valve not opened)	Reactor may pressurize	1.PT is available with high and high high alarm. 2.PG is also provided on reactor. 3.Trained manpower is deputed for operation.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.Reactor design pressure up to 6bar.							
			PVRV chocked of U/G tank	Tank may implode	1.PM of PVRV is performed as per schedule. 2.PT is provided on tank. 3.Tank is design for full vacuum.	3	4	12				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	2	4				
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow	1.Trained manpower is deputed for DCS operation.	3	3	9				
		Reverse										
		Mis-directed flow	Human error(Wrong line up)	Line may pressurize	1. Double manual valve is available at toluene header. 2.Trained manpower is deputed for operation.	3	3	9				
2	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard & fire hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
			Refer low flow									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		**Grignard mass (S-2) transferring in EO coupling reactor(042RT-089) by N2 pressure**										

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard/Process Delay								
		High/More	High pressure of N2 in N2 line	No HSE hazard/Process Delay								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause	No HSE hazard								
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurize	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.N2 line maximum pressure is 3 kg/cm2. 4.Double valve is provided in N2 supply line.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Manual vent line/vapour line valve is not open of reactor)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available in reactor with high and high high alarm.	3	4	12				
9	Temperature	Low	Human error(Brine supply valve open)	No HSE hazard/Process Delay	TI is available on reactor with low and low low alarm	3	1	3				
		High	Human error(Steam manual valve open/passed)	Temperature rise in reactor	1.TI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation.	3	4	12				
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3.Fire extinguisher and fire hydrant point is provided in near by area. 4.All electrical installation as per HAC classification.	3	3	9				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Tube bundle leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of tube bundle is performed periodically. 3. Incompatible hazard is not there between utility media and reaction mass.	3	3	9				
11	Composition	Other than		No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9				
		Instrument Air failure		No HSE hazard								
		Power Failure		No HSE hazard								
		DCS Failure		No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-3		**EO addition in EO coupling reactor (042RT-075) from EO day tank (2KL)**										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of EO day tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (manual valve of EO receiving line on EO coupling reactor not opened).	Transferring line may pressurise	1.Line design pressure is sustain to maximum pressure.	3	3	9				
			Low pressure of N2 in EO day tank	No HSE hazard/Process Delay	1.PT is available in day tank with low and low low alarm.	3	1	3				
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Fire extinguisher and fire hydrant point is provided in near by area. 3. Flange guard is provided on all flanges. 4.Compatible gasket issued. 5.All electrical installation as per HAC classification.	3	4	12				
			Low level in EO day tank(2KL)	No HSE hazard/Process Delay	1.Flow meter is available in addition line . 2.Loadcell is	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					available in EO day tank with alarms.							
			Flow meter malfunctioning/ chocked	No HSE hazard/Proces s Delay	1.Flow meter PM to be performed before start the operation. 2. Choking not possible.	3	1	3				
			FCV of EO addition line stuck	No HSE hazard/Proces s Delay	PM of FCV is performed as per schedule.	3	1	3				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 3. TI is available in the reactor with high and high high alarms. 4. CHBS provision is available in jacket of the reactor to control temperature.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
			FCV of EO addition line stuck		PM of FCV is performed as per schedule.	3	4	12				
		Reverse	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened) during addition	Reactor may pressurise	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the reactor with HH alarms.	3	4	12				
			FCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					condition. 2.Double valve is provided in N2 supply line.							
			Human error(EO addition rate fast)		Refer high flow safeguard	3	4	12				
			Failure of brine circulation in jacket of the reactor		1.Flow meter is available in brine supply line with low and low low alarm. 2.Brine circulation pump running indication is available on DCS.	3	4	12				
			Utility failure in tube bundle of coupling reactor		1.Flow meter is available in brine supply line with low and low low alarm. 2.Brine circulation pump running indication is available on DCS.	3	4	12				
15	Temperature	Low	Brine supply valve opened/passed	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation.	3	4	12				
			FCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition.	3	4	12				
			Human error(FCV bypass line passed/open)		Trained manpower is deputed for operation.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Failure of brine circulation in jacket of the reactor		1.Flow meter is available in brine supply line with low and low low alarm. 2.Brine circulation pump running indication is available on DCS. 3.TI is available in final vent line with high and high high alarm.	3	4	12				
			Utility failure in tube bundle of coupling reactor		1.Flow meter is available in brine supply line with low and low low alarm. 2.Brine circulation pump running indication is available on DCS.	3	4	12				
			Fast addition rate		Refer high flow safeguard							
16	Level	Low	Reactor Bottom valve left open/pass	health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Tube bundle leakage of the reactor	No HSE hazard	1.Before startup thickness testing is performed. 2.Compatible utility is used.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 17/03/2017**			
Node 10		**Node Description : EO coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Other	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	4	8				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.Agitator running indication is available on DCS.	2	4	8				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 11		**Node Description : Coupling mass storage reactor(043RT-082)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Coupling mass transfer to storage reactor(043RT-082) by pump**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.	3	1	3				
			Human error (receiving line on reactor valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2.Line pressure testing is done before start up.	3	3	9				
			coupling mass Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 11		**Node Description : Coupling mass storage reactor(043RT-082)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.							
			No level in coupling reactor	No HSE hazard	No existing safeguard	2	1	2				
			Human error (Vent line of storage reactor valve not opened)	Reactor may pressurize	1.PT is available with high and high high alarm. 2.PG is also provided on reactor. 3.Trained manpower is deputed for operation. 4.Reactor design pressure up to 6bar.	3	4	12				
		High/More	No probable cause									
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard	3	2	6				
		Mis-directed flow										

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 11		**Node Description : Coupling mass storage reactor(043RT-082)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available with high and high high alarm. 2.PG is also provided on reactor. 3.Trained manpower is deputed for operation. 4.Reactor design pressure up to 6bar.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard	TI is available in reactor with low and low low alarm							
		High	No probable cause	No HSE hazard	TI is available in reactor with high and high high alarm							
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard & fire hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 11		**Node Description : Coupling mass storage reactor(043RT-082)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					spillage. 4. Flange guard to be provided on all flanges.							
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
			Refer low flow									
		High	Refer High/More flow									
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 11		**Node Description : Coupling mass storage reactor(043RT-082)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**20% H2SO4 charging in quenching reactor (041RT-091)**										
1	Quantity/Flow	No/Less	Human error (Discharge manual valve not opened).	No HSE hazard/Process Delay	Trained manpower is deputed for operation and ensure proper lineup before startup.	3	1	3				
			Transferring pump trip/stop	No HSE hazard/Process Delay	Pump running indication is available on DCS.	3	1	3				
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket is used.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpower is deputed for operation and ensure proper lineup before startup. 2. PT is available in the reactor with alarms.	3	4	12				
			Low level in 15%H2SO4 tank	No HSE hazard	1.LI is available on tank with low and low low alarm.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunction	Process delay	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	1. Overflow from reactor may lead to spillage hazard	1.Trained manpower is deputed for operation and ensure proper line up before startup. 2. Reactor vent is connected to condenser .so, less chances of overflow.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpower is deputed for operation and ensure proper line up before startup. 2. PT is available in the reactor with alarms.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	3	4	12				
3	Temperature	Low	No probable cause		TI is available in reactor with low and low low alarm.							
		High	No probable cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				hazard may possible	is used in jacket of the reactor.							
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	4	8				
		Power Failure	GEB power failure	No HSE hazard								
			DG failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	No probable cause									
Stream-2		**Coupling mass addition to quenching reactor (041RT-091) from coupling mass storage reactor**										
7	Quantity/Flow	No/Less	Human error (Discharge manual valve not opened).	No HSE hazard/Process Delay	Trained manpower is deputed for operation and ensure proper lineup before startup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage	Health & fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpower is deputed for operation and ensure proper lineup before startup. 2. PT is available in the reactor with alarms.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Low level in coupling mass storage reactor	No HSE hazard	No existing safeguard	3	1	3				
		High/More	Human error (More percentage of manual valve is open)	1. Overflow from reactor may lead to spillage hazard 2.Exotherm may possible in the reactor	1.Trained manpower is deputed for opetration and ensure proper line up before startup. 2. Reactor vent is connected to condenser .so,less chances of overflow. 3. Chilling & cooling utility supply provision is available to control temperature. 4.TI is available in the reactor with high and high high alarm.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. Trained manpower is deputed for opetration and ensure proper line up before startup. 2. PT is available in the reactor with alarms.	3	4	12				
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	3	4	12				
9	Temperature	Low	Human error(Chilling water supply valve open)	No HSE hazard/Process Delay								
		High	Refer High/More flow	Temperature rise may possible in the reactor								
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of RTD is performed before startup.	3	4	12				
			Human error(Steam TCV open)		Manual valave is available in line of steam.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in jacket of the reactor		1.RTD is available in chilling supply & return line.	3	4	12				
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Reactor leakage	Incompatible hazard may possible.	PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
11	Composition	Other than		No HSE hazard								
12	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor & tantalum plug is also provided. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	4	8				
		Power Failure	GEB power failure/DG failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in reactor	1.Agitator running indication is available on DCS.	3	4	12				
Stream-3		**Water charging in quenching reactor (041RT-091)**										
13	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow.	3	1	3				
			Line leakage	No HSE hazard/Process Delay	1.Line pressure testing is done before start-up. 2.Compatible gasket is used.	3	1	3				
			No level in Soft water tank	No HSE hazard/Process Delay	1. Flow meter is available in the line to monitor the flow.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms.	3	4	12				
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	1	3				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	No existing safeguard	3	1	3				
			Flow meter malfunction		1.Flow meter PM is performed as per predefined schedule.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
14	Pressure	Low	No probable cause									
		High	Human error (Vent line	Reactor may pressurise	1. SOP is available to open vent valve	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			valve not opened)		before starting transferring activity. 2. PT is available in the reactor .							
15	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
16	Level	Low	Reactor Bottom valve left open/pass	No HSE hazard/Process Delay	Trained manpower and SOP is available before line up.	2	1	2				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	1	2				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	1	2				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					is used in jacket of the reactor.							
17	Composition	Other than	No probable cause	No HSE hazard								
18	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	Air compressor failure	Reactor may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	4	8				
		Power Failure	-	No HSE hazard								
		DCS Failure	-	No HSE hazard								
		Agitation	-	No HSE hazard								
Stream-4		**Aqueous transfering in aqueous tank(040ST-126) from 040ST-156(1KL)**										
19	Quantity/Flow	No/Less	Line leakage	No HSE hazard/Process Delay	1. Line testing done before start-up. 2. Compatible gasket is used.	2	1	2				
		High/More	No probable cause									
		Reverse	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
20	Pressure	Low pressure in 1KL tank	Human errror(Vent valve closed of 1KL HDPE tank)	Tank may implode	No existing safeguard	3	4	12				
		High pressure in 30KL tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12				
21	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
22	Level	Low	Aqueous tank leakage, aqueous transfering line valve pass/leakage	No HSE hazard								
		High level in 1KL tank	More aqueous charge	Overflow from tank may possible	1.Level switch is available in tank.	3	3	9				
		High level in 30KL tank	More aqueous charge	Overflow from tank may possible	1.LI is available with high and high high alarm.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
23	Composition	Other than										
24	Others	Static charge	No probable cause	No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									
Stream-5		**Organic transfering in organic tank/1000 dia column feed tank(040ST-129) from 040ST-158(1KL)**										
25	Quantity/Flow	No/Less	Line leakage	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			Transferring pump trip/stop	No HSE hazard/Process Delay	Pump running indication is available on DCS.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
26	Pressure	Low pressure in 1KL tank(	Human errror(Vent valve closed of 1KL organic tank)	Tank may implode	No existing safeguard	3	4	12				
		High pressure in 15KL tank	Human error(Vent line valve closed)	Tank may pressurise	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.PT is available in tank with high and high high alarm.	3	4	12				
27	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
28	Level	Low	Organic tank leakage, Organic transfering line valve pass/leakage	Health hazard and fire hazard may possible	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
		High level in 1KL tank	More organic charge	Overflow from tank may possible	1.Level switch is available in tank .	3	3	9				
		High level in 15KL tank	More organic charge	Overflow from tank may possible	1.LI is available with high and high high alarm. 2.Level switch is available in tank .	3	3	9				
29	Composition	Other than										
30	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the reactor & tantalum plug is also provided. 2. Earthing strip is provided on the flanges. 3.Earthing continuity	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 12		**Node Description : Quenching reactor(041RT-091)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					is verified before start up.							
		Instrument Air failure	Air compressor failure	Feed tank may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	2	4	8				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from storage tank(40ST-146) to distillation column(041CM-046) through feeding pump(040TP-289A)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line. 1.Pump running indication is provide on DCS.	3	1	3				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up.	3	3	9				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			No/low level in tank	No HSE hazard/Process Delay	1.LI is provided in tank to monitor the level of tank on DCS.	3	1	3				
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**				
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					operation before start-up. 3.PM of flow meter to be performed before startup.							
			Flame arrestor chocked in vent line	Column may pressurise	1.Flame arrestor PM is performed as per PM scudule.	3	4	12				
			Human error(Vent line manual valve is closed)	Column may pressurise	1.PT is available in column top and bottom. 2.Trained manpower is deputed for operation.	3	4	12				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.VFD is available in pump.							
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2	**Continuous distillation in distillation column (041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					with high and high high alarm.							
			Flame arrestor chocked in vent line		1.2 no of PT is available in distillation column with high and high high alarm.	3	4	12				
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					primary to secondary condenser line. 6.TI is provided in final vent line of the distillation column.							
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	3	4	12				
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	4	8				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					flameproof in near by area.							
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3				
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3				
			Human error (steam TCV is not open)		1.steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column	3	1	4				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					with high and high high alarm.							
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									

HAZOP study of T2E project at 8203 site											
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	2	6				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3	**Top collection in receiver(043TK-228)**											

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Trained manpower will deputed for operation and verified valve position before startup.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				
			Utility failure in condenser	Fire hazard and chemical exposure	Refer utility failure in stream 2	2	3	6				
			Top collection line CV stuck	No HSE hazard/Process Delay	CV stuck testing is performed as per PM schdule.	2	1	2				
			Vent line valve is not open	Receiver may pressurize	1.PG is available on receiver. 2.Receiver design pressure is upto 6kg/cm2.	2	4	8				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for DCS operation. 2.Steam TCV indication is provided on DCS.	2	1	2				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard. 5.Level switch is available in receiver.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.TI is also available in reciver with high and high high alarm.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Receiver may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PG is available to monitor the pressure of receiver. 3.Receiver design	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pressure is upto 6 bar.							
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver. 4.LSH is also available in the receiver.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-4		**Bottom withdrawal in tank (041TK-229)**										
19	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6.All electrical equipment are flameproof in near by area.							
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Trained manpower will deputed for operation and verified valve position before startup.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	1.LI is available in sump of the distillation column.	2	1	2				
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay	CV stuck testing is performed as per PM schdule.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vent line valve is not open	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.PT is provided in collection tank with high and high high alarm.	3	4	12				
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3				
		High/More	Bottom collection CV passed	Overflow may possible	1.LI is available in tank with high and high high alarm. 2.PM of bottom collection line FCV is performed as per predefine schdule.	3	3	9				
			Bypass valve of CV passed/left open									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.PT is provided in collection tank with high and high high alarm.	3	4	12				
			Flame arrestor chocked in vent line		1.Material having no chocking property.	3	4	12				
21	Temperature	Low	No probable cause									
		High	Utility failure in product cooler	Temperature rise in bottom collection tank	1.TI is available in bottom collection tank with high and high high alarm. 2.TI is available in utility supply line of product cooler.	3	3	9				
22	Level	Low	Tank leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI is available in the tank with low and low low alarms.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	2	3	6				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-5		**Top collection receiver(043TK-228) unloading in THF + 5% M/C storage tank(041ST-130)**										
25	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			No/low level in receiver	No HSE hazard/Process Delay	Loadcell is available in receiver to monitor the levell of receiver.	2	1	2				
			PVRV chocked in vent line	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. PM of PVRV is performed as per schedule.	3	4	12				
		High/More	Tube leakage in condenser	Tank may overflow	1.Pressure test is performed before start-up. 2.LI is available in tank with high and high high alarms.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
26	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	PVRV chocked in vent line	Tank may pressurize	1.Local vent is provided in the tank. 2. PT is available to monitor the pressure of tank with hiigh and high high alarm. 3.Tank design pressure is upto 6 bar. 4.PM of PVRV is performed as per predefine schedule.	3	4	12				
			N2 line PRV failure		1.Local vent is provided in the tank. 2. PT is available to monitor the pressure of tank with hiigh and high high alarm. 3.Tank design pressure is upto 6 bar. 4.PM of PRV is performed as per predefine schedule. 5.N2 line maximum	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 13		**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pressure is 1.5kg/cm2.							
27	Temperature	Low	No probable cause									
		High	No probable cause									
28	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1. Tank design pressure is 6 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. LI is available in the tank.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
29	Composition	Other than	No probable cause									

HAZOP study of T2E project at 8203 site											
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**		
Node 13	**Node Description : Continuous THF distillation column(041CM-046)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
30	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from storage tank(40TK-229) to distillation column(041CM-047) through feeding pump(040TP-291A)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	3	1	3				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					flameproof in near by area.							
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up.	3	3	9				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			No/low level in tank	No HSE hazard/Process Delay	LI is available in tank with low and low low alarms.	3	1	3				
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					ensure valve operation before start-up. 3.PM of flow meter to be performed before startup.							
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.VFD is provided in motor of the pump.	3	3	9				
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					sump of the column with high and high high alarms.							
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				
2	Pressure	Low pressure in feeding tank	Human error(vent line valve closed)	Tank may implode	1.Trained manpower is deputed for operation. 2.PT is available in tank . 3.Tank is design for full vacuum.	3	4	12				
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (041CM-047)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low/no vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Vacuum transmitter is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms.	3	4	12				
		High	Utility failure in condenser	Temperature & pressure rise may possible in column	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.3 no of PT is available in column with high and high high alarm.							
9	Temperature	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9				
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	3	3	9	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					the column. 4.3 no of TI is provided in distillation column.							
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3				
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					withdrawal line with indication in DCS.							
			Human error (Oil TCV is not open)		1.Oil TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	3	1	3				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					incompatible hazard.							
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-3		**Top collection in receiver(043TK-230)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.							
			Top collection line CV stuck	No HSE hazard	PM of top collection CV is performed as per predefine schedule.	3	1	3				
			Heating stopped	No HSE hazard/Process Delay	Steam TCV opening percentage indication is provided on DCS.	3	1	3				
			Flow meter malfunction in collection line	No HSE hazard/Process Delay	PM of top collection line flow meter is performed as per predefine schedule.	3	1	3				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.							
			Human error(Oil TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	3	4	12				
			Top collection line CV stuck	Receiver may overflow	PM of top collection CV is performed as per predefine schedule. 2.No open vent in receiver.so, no chances of overflow.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent/vacuum balancing line valve is not opened)	Receiver may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.PG is available in receiver.	3	4	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				
		High	Refer high Flow									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal in tank (042TK-232)**										
19	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in	1.Bottom withdrawal pump running indication is	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				column/Process Delay	available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.							
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay								
			Vent line/vacuum line valve is not open	No HSE hazard/Process Delay								
			Flow meter malfunction in bottom collection line	Process delay	LI is available in receiver with low and low low alarms.	3	1	3				
		High/More	Bottom collection CV passed	Overflow may possible		3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bypass valve of CV passed/left open		1.LI is available in receiver with high and high high alarm.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent/vacuum valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.PG is provided in bottom collection tank .	3	4	12				
			N2 line manual valve passed/left open		1.N2 line maximum pressure is 3kg/cm2. 2.Bottom collection tank design pressure is 6kg/cm2.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
21	Temperature	Low	No probable cause									
		High	No probable cause									
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI available in the tank with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-5	**Top collection receiver(043TK-230) unloading in recovered toluene tank(040TK-231)**											
25	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					flameproof in near by area.							
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in receiver	No HSE hazard/Process Delay	Load cell is available in receiver to monitor the level of receiver.	2	1	2				
			Human error(manual vent line valve is closed)	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. 3.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
		High/More	Human error(withdrawal not done regularly)	Tank may overflow	1.Trained manpower is deputed for operation. 2.LI is available in	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					tank with high and high high alarms.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
26	Pressure	Low	No probable cause									
		High	Human error(manual vent line valve is closed)	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. 3.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
			N2 line PRV failure		1.Local vent is provided in the tank. 2. PT is available to monitor the pressure of tank with high and high high alarm.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14		**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Tank design pressure is upto 6 bar. 4.PM of PRV is performed as per predefine schedule. 5.N2 line maximum pressure is 1.5kg/cm2.							
27	Temperature	Low	No probable cause									
		High	No probable cause									
28	Level	Low	Tank leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. LI is available in tank with low and low low alarm	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 14	**Node Description : Continuous Toluene distillation column(Bromo benzene distillation column)(041CM-047)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
29	Composition	Other than	No probable cause									
30	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	Tank may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1	**Crude T2E transfer from (042TK-232) column bottom receiver to T2E batch distillation reactor(041RT-092)**											
1	Quantity/Flow	No/Less	Human error (Discharge manual valve not opened).	No HSE hazard/Process Delay	1. Trained manpower will deputed for crude charging and ensure proper line up before start transferring.	3	1	3				
			Line/Flange leakage	Fire & health hazard due to spillage	1.Line leakage testing is done before start-up . 2.Compatible gasket is used. 3.All electrical installation are flameproof as per HAC classification. 4. Fire extinguishers are available in nearby places.	3	3	9				
			Human error(vent/ Vacuum line PCV is not open in T2E batch distillation reactor)	Reactor may pressurize	1.PT is available in the reactor with high and high high alarms. 2.Trained manpower is deputed for operation.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15		**Node Description : T2E batch distillation column(041CM-050)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Reactor design pressure is up to 6 bar.							
			Human error(vent is not open in CM bottom receiver)	Receiver may implode	1.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
		High/More	No probable cause									
		Reverse										
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent/ Vacuum line PCV is not open in T2E batch distillation reactor)	Reactor may pressurize	1.PT is available in the reactor with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Reactor design pressure is up to 6 bar.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 manual valve passed/left open		1.Vent/vacuum line PCV is provided on reactor and verified by supervisor that valve is open during transferring. 2.PT is available in reactor with high and high high alarms. 3.Reactor design pressure is unto 6 bar.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Tank body leakage	Fire & health hazard due to spillage	1.Material is compatible with reactor MOC 2.Pressure testing is performed before startup. 3.Fire extinguishers are available in nearby places.	2	3	6				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.PM of reactor is performed as per predefine schedule.							
			Tank bottom valve leakage/passed		No existing safeguard	2	3	6				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	PM of reactor is performed as per predefine schedule.	2	3	6				
5	Composition	Other than	No credible cause									
6	Others	Static Electricity	-	Fire hazard	1. Earthing continuity is verified before startup. 2. Dual earthing is provided in the reactor.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15		**Node Description : T2E batch distillation column(041CM-050)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					is done for the same periodically.							
		Agitation	Not applicable									
Stream-2		**Pure T2E distillation in batch distillation reactor(041RT-092) & (041CM-050)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3.Vacuum is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High Vacuum	No probable cause	No HSE hazard								
		High	Utility failure in condenser	Temperature rise may possible in the reactor	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water/chilling water circulation pump is available on DCS.	3	4	12				
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15		**Node Description : T2E batch distillation column(041CM-050)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.All electrical installation are flameproof as per HAC classification.							
		High	Jacket puncture of the reactor	Reactor may overflow	1.Reactor MOC is suitable with crude. 2.PM of reactor is performed as per predefine schedule. 3.No open vent in reactor .so no chances of overflow.	3	3	9				
			Tube leakage in condenser		PM of tube leakage is performed before startup.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.Oil TCV to be closed in case of agitator stop/trip.	3	4	12				
Stream-3	**Collection of pure T2E in receiver (043TK233A&233B)**											
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15		**Node Description : T2E batch distillation column(041CM-050)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					equipment are flameproof in near by area.							
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15		**Node Description : T2E batch distillation column(041CM-050)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					provided in cooling water supply line in condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.							
			Top collection line CV stuck	No HSE hazard	CV struck testing is performed as per PM schedule.	2	1	2				
			Heating stopped(Oil TCV closed)	No HSE hazard/Process Delay	Oil TCV indication is available on DCS with percentage.	2	1	2				
			Top collection line flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	2	1	2				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 1.Flow meter is available in collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.	3	3	9				
			Human error(Oil TCV more percentage open)	Receiver may overflow	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Receiver having no open vent.so,no chances of overflow.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
14	Pressure	Low	No probable cause									
		High	Human error(Manual vacuum balancing line valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.Receiver design pressure is unto 6 bar.	3	4	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15		**Node Description : T2E batch distillation column(041CM-050)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Not applicable									
Stream-4	**Mix cut receiver(043TK-233A) unloading in toluene distillation column bottom withdrawal tank(042TK-232)**											
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			No/low level in receiver	No HSE hazard/Process Delay	No existing safeguard	3	1	3				
		High/More	Human error(withdrawal not done at regularly)	Tank may overflow	1.LI is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(vent line valve closed)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.Receiver design pressure is up to 6 bar.	3	4	12				
21	Temperature	Low	No probable cause									
		High	No probable cause									

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06			**Title : HAZOP study of T2E project at 8203 site**						**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of T2E project at 8203 site												
P&ID of T2E_Plant-06		**Title : HAZOP study of T2E project at 8203 site**							**Plant Name: Plant-1, Date- 18/03/2017**			
Node 15	**Node Description : T2E batch distillation column(041CM-050)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

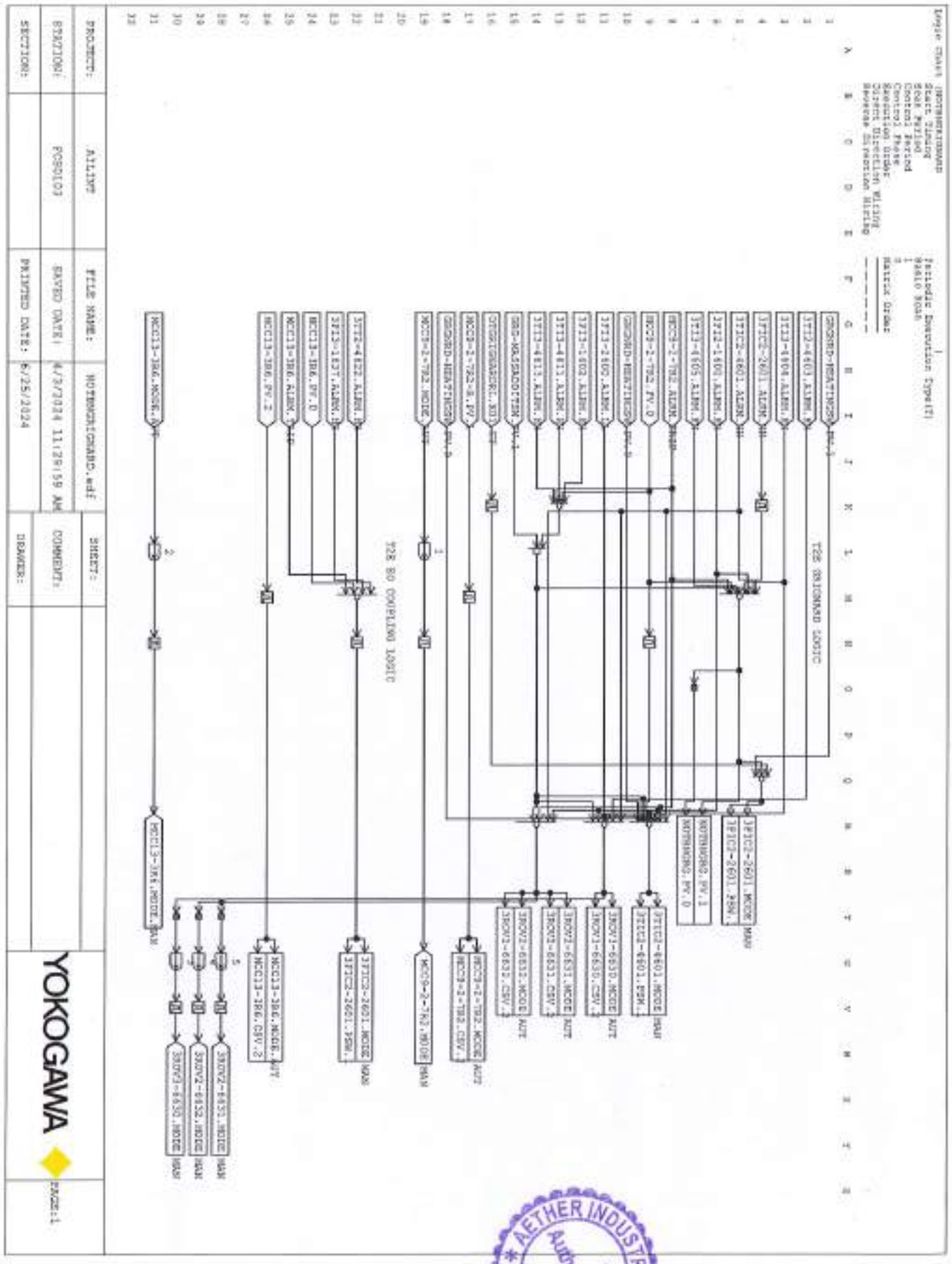
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T2E HAZOP Recommendation Summary						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	Thiophene day tank (040TK-285)	Thiophene drum charging in day tank (040TK-285) by using vacuum	Flange guard to be provided on all flanges.	Mechanical	Completed	1
2	Halogenation reactor(043RT-110)	30%HCl charging in the halogenation reactor (043RT-110) from HCl tank	Recommend to freez the upper limit of totaliser as per process requirement.	Production	Completed	2
3	Aqueous tank(040ST-185)	Aqueous transfering in aqueous tank(040ST-185) from halogenation reactor(043RT-110)	Vent line valve should be locked open condition withy tagging	Mechanical	Completed	3
4	Grignard reactor(042RT-086)	THF + 2CT addition in grignard reactor (042RT-086) from grignard addition reactor (043RT-083)	Vent line valve should be always locked open condition with tagging.	Mechanical	Completed	4
5	Continuous Toluene distillation column(Bromo benzene distillation	Continuous feeding from storage tank(40TK-229) to distillation column(041CM-047) through feeding pump(040TP-291A)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	5

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PRINTED DATE: 6/25/2024
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HAZOP STUDY REPORT OF

2CE-CEE (PLANT-1)

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

JUNE 2017

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Process Safety Engineers

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HAZOP STUDY REPORT OF

2CE-CEE (PLANT-1)

JUNE 2017

By

NEXA PROCESS SAFETY ENGINEERS

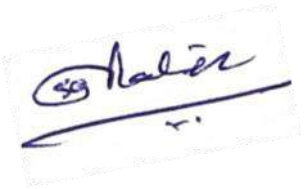
NEXA Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.





Surat **Proprietor**

12/06/2017 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for 2CE-CEE product.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for 2CE-CEE product of Plant 1. It has 8 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	EO INT TANK(013TK-127A/B)
2.	EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)
3.	2CE absorption mass storage tank(011ST-035/011ST-036)
4.	011CM-018 (Continuous Distillation Column)
5.	021CM-066 (Continuous Distillation Column)
6.	CEE pure distillation reactor(011RT-042)
7.	2CE distillation reactor(011RT-158)
8.	2CE distillation reactor(021RT-155)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other’s ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.

5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be

subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

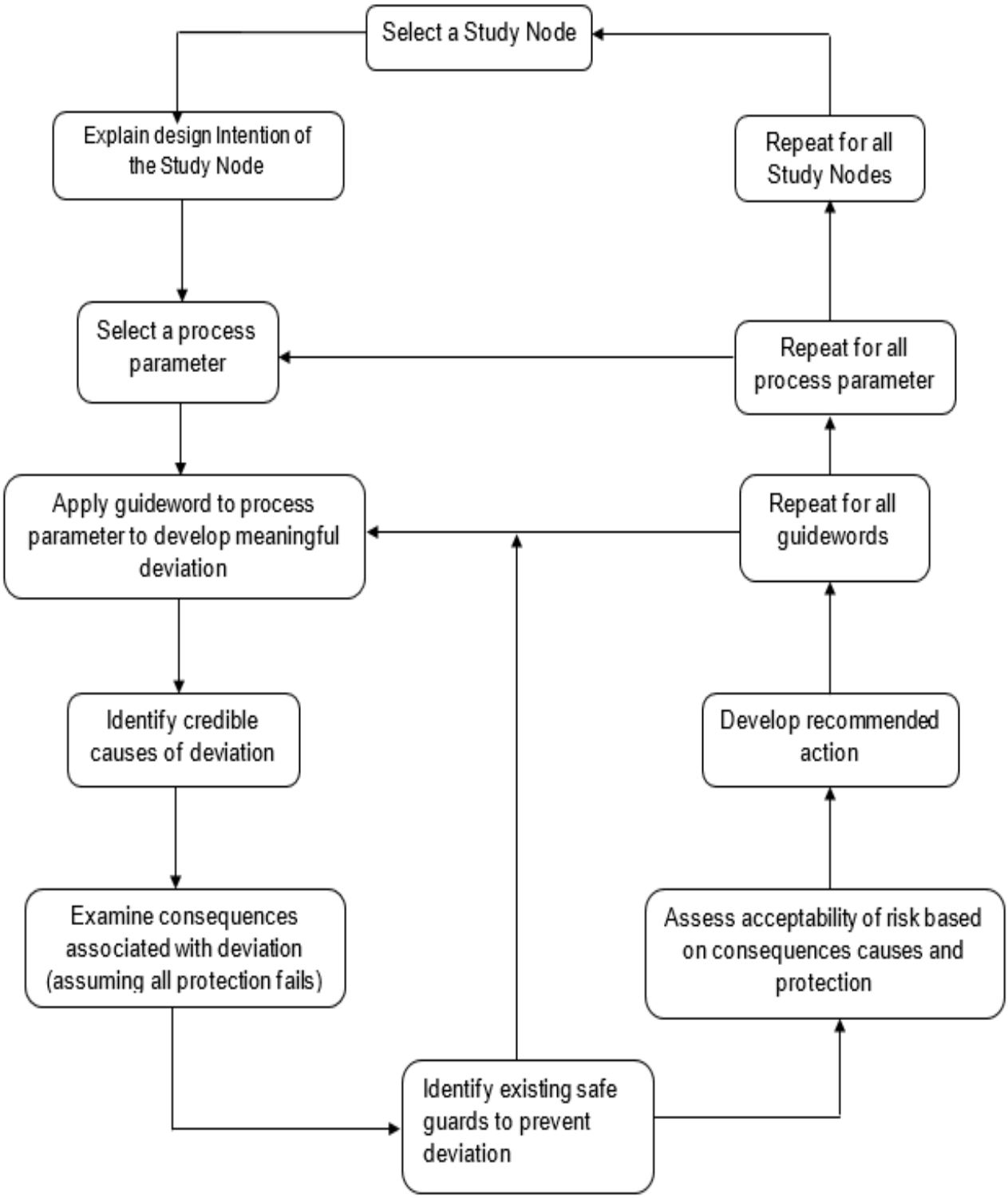
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	AIL-PID-2CE-SHEET-1

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

HAZOP-2CE				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)	Pure 2CE mass charging in EO + 2CE absorption reactor(013RT-038) from 2CE pure storage tank(010TK-255) &(010TK-256)	Flange guard to be provided in transferring line.	Mechanical
2			Blind to be provided to all drain point open end flanges.	Mechanical
3	2CE absorption mass storage tank(011ST-035/011ST-036)	2CE absorption mass transferring in storage tank from EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)	Flange guard to be provide on the flanges.	Mechanical
4	011CM-018 (Continuous Distillation Column)	Continuous distillation in distillation column (011CM-018)	TCV bypass valve should be locked closed condition with tagging.	Mechanical
5	021CM-066 (Continuous Distillation Column)	Bottom withdrawal taken in CM-018 & 066 bottom withdrawal tank (010ST-212)	Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Mechanical
6	CEE pure distillation reactor(011RT-042)	Pure CEE distillation in CEE pure distillation reactor(011RT-042)	TCV bypass valve should be locked closed condition with tagging.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**EO transferring in EO day tank (013TK-127A/B) from EO storage tank**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (receiving line on Day tank valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	3	6				
			Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank with low and low low alarms.	2	2	4				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 1	**Node Description : EO INT TANK(013TK-127A/B)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					near by area. 6.All electrical equipment are flameproof in near by area. 7. EO sensor is provided in near by day tank. 8.Interlock is provided to closed EO transferring line ROV at high high value of EO sensor of EO day tank. 9.Flash alarm is provided at HH value of EO detector sensor.							
			No level in tank	No HSE hazard/Process Delay	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line. 3.Interlock is provided to close the transferring line ROV at LL value of LI of storage tank.	2	1	2				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	Day tank may overflow	1.Trained manpower is deputed for DCS operation. 2.Day tank vent is given in dumped tank. 3.Loadcell is available on day tank with high and high high alarm. 4.LSH is available on day tank. 5.Upper limit is freezed in the totaliser to prevent more transferring of EO. 6.Interlock is provided to close ROV at given set value achieve in totaliser. 7.Interlock is provided to closed EO transferring line ROV at HH value of load cell of EO day tank. 8.Flash alarm is provided on HH value of loadcell of EO day tank. 9.interlock is provided to closed transferring line ROV at LSH activation. 10.Flash alarm is provided on LSH activation.	3	3	9				
		Reverse										
		Mis-directed	Human	Line may	1. Double manual valve is	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 1	**Node Description : EO INT TANK(013TK-127A/B)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		flow	error(Wrong line up)	pressurize	available at EO header. 2.Trained manpower is deputed for operation. 3.Identification mark is provided on transferring line at main header of EO. 4.ROV is provided in separate EO line (T2E & MEP) at plant header. 5. interlock is provided to open only one ROV out of all ROV at EO header.							
2	Pressure	Low	No probable cause									
		High	N2 line manual valve passed/left open	Day tank may pressurise	1.Double manual valve is provided in N2 line. 2.Tank design pressure is upto 6 bar. 3.PRV is available in main nitrogen line. 4.Pressure transmitter is available with high and high high alarm. 5.PSV is available on day tank. 6.Flash alarm is provided on high high pressure of the day tank. 7.Interlock is provided to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					closed the transferring line ROV at HH pressure of the day tank.							
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Chilling circulation failure due to chilling plant issue	Tank may pressurise due to temperature rise in day tank	1.TI is available on day tank with high and high alarm. 2.TI is available in chilling water return line with high high alarm. 3.Chilling plant pump trip/stop indication is available on DCS with alarm. 4.Flash alarm is provided on high high temperature of the day tank. 5.Interlock is provided to closed the transferring line ROV at HH temperature of the day tank.	3	4	12				
4	Level	Low	Loadcell malfunction	No HSE hazard/Process Delay	PM of loadcell is performed before startup.	2	3	6				
			Bottom valve leakage/passed	Health hazard & fire hazard due to spillage	SS compatible valve and metallic gasket is used. 2.Double manual valve is provided on bottom of the tank.	2	3	6				
			Line/Flange		Line pressure test is	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			leakage		performed before start up.							
			Tank body leakage		1.Tank MOC is compatible with material.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.ROV of EO transferring line air failed safe position is air failed to closed.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Pure 2CE mass charging in EO + 2CE absorption reactor(013RT-038) from 2CE pure storage tank(010TK-255) &(010TK-256)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of 2CE storage tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Loadcell is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Line pressure test is performed before startup. 5.Compatible gasket to be used to prevent gasket leakage. 6.Over load protection is provided in material transferring pump. 7.Spill kit is provided in nearby area to contain spillage.	3	3	9	1.Flange guard to be provided in transferring line.	2	3	6
			Human error (manual valve of 2CE storage receiving line of absorption reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Compatible gasket is used to prevent gasket leakage.	3	3	9				
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1.Trained manpower is deputed for operation and ensure proper line up before startup.	3	3	9	1.Blind to be provided to all drain point open end flanges.	2	3	6
			Human error (Circulation line valve open/pass) in storage tank	No HSE hazard/Process Delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	1	2				
			Low level in storage tank	No HSE hazard/Process Delay	1. Loadcell is available in the tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Valve chocked/flow meter choked	Line may pressurise and lead to spillage	Material having no choking property.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				/health hazard & fire hazard								
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health& fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vent line is connected with scrubber or no open vent in reactor.so, no chances of overflow. 3.Upper limit of the totaliser is freezed as per process requirement.	3	3	9				
		Reverse	Pump trip/stop	Pump mechanical failure	NRV is provided in pump discharge line.	3	2	6				
		Mis-directed flow	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low pressure in storage tank(010 TK-255/256)	Human error (Vent line valve of 2CE storage tank not opened) 2.vent line chocked	Storage tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4.Storage tank is design for full vacuum. 5.Interlock is provided to stop transferring pump at low low alarm of PT of storage tank. 6. Vent line valve is locked open condition with locked open indication tag .	3	4	12				
		High	Human Error (During 2CE storage charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar. 5. Interlock is provided to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					close the charging pump at HH value of PT of reactor.And same XV to be closed after 20 sec of pump stop. 6.Flash alarm is provided on HH alarm of PT of the reactor.							
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3. N2 inertisation is performed during charging. 4.Tantalum plug is provided in reactor. 5.Rotameter is provided in nitrogen supply line to ensure nitrogen flow.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Interlock is provided that if XV closed in transferring line than same time transferring pump to be stop. 4.2CE storage charging line XV air failed safe position is air failed to closed condition.	3	3	9				
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**Dry HCl gas purging in EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
7	Quantity/Flow	Low/Less	Dry HCl plant stop	No HSE hazard/Process Delay	1.Dry HCl plant all equipment indication is available on DCS.	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage	Health and fire hazard may possible	1.Line pressure and leakage test is performed before start-up. 2. Compatible gasket is used.	3	3	9				
			Flow meter malfunctioning	No HSE hazard/Process Delay	1.Flow meter PM is performed as per predefine schedule.							
			Human error(manual valve of dry HCl gas receving line is closed on absroption reactor)	Line may pressurise and lead to spillage /health hazard	1.Line pressure testing is performed before start up. 2.Compatible gasket is used .							
		High/More	Human error (Wrong set point is given in flowmeter with totaliser)	Temperature and pressure rise may possible in the absroption reactor	1.Trained manpower is deputed for DCS operation . 2.PT is provided in reactor with high and high high alarm. 3.TI is available with high and high high alarm. 4.Interlock is provided to closed the HCl purging line ROV at HH pressure and HH temperature of the absorption reactor. 5.Flash alarm is provided	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					on HH temperature and HH pressure of the absorption reactor. 6.Upper limit of the flow meter and totaliser is freez as per process requirements.							
			Flow meter malfunctioning	No HSE hazard/Process Delay	1.Flow meter PM is performed as per predefine schedule.	3	2	6				
		Mis-directed flow	Wrong line up	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure proper line up before startup. 2.ROV is avaiable in dry HCL purging line of all absotption reactor. 3.Interlock is provided to open the only one ROV of dry HCl purging line out of all ROV of dry HCl purging line.	3	2	6				
8	Pressure	Low	Refer high Flow									
		High	Refer high flow	Reactor may pressurise and								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Reactor vent/Vapor line valve closed (Human error)	gas generation may possible	1.PT is provided in the absorption reactor with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4. initerlock is provided to closed dry HCl purging line ROV at HH pressure of the reactor. 5.Flash alarm is provided on HH pressure of the reactor.	3	4	12				
			Scrubber failure		1.scrubber circulation pump indication is available on DCS. 2. interlock is provided to closed the dry HCl gas charging line XV incase of scrubber circulation pump trip/stop.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utiity(chilling brine) circulation failure		1.Brine circulation pump running indication is available on DCS. 2.TI is provided in utility supply and return line of the absorption reactor. 3.Interlock is provided to closed dry HCl gas purging line XV incase of brine pump circulation pump trip/stop. 4.Flash alarm is provided incase of brine plant circulation pump trip/stop.	3	4	12				
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Refer high Flow									
			TI malfunctioning	Temperature rise may possible in the reactor	PM of TI is performed as per predefine schedule.	3	4	12				
			Utility (chilling brine) circulation failure		1.Brine circulation pump running indication is available on DCS. 2.TI is provided in utility supply and return line of the absorption reactor. 3.Interlock is provided to closed dry HCl gas purging line XV incase of brine pump circulation pump	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					trip/stop. 4.Flash alarm is provided incase of brine plant circulation all pump trip/stop.							
			Parallel material charging of dry HCl and EO inplace of series		1.Trained manpower is deputed for DCS operation. 1.Interlock is provided that only one ROV will open either dry HCl purging line or EO addition line at same time.	3	4	12				
10	Level	Low	Refer low flow									
			Refer high flow									
		High	Jacket puncture of the reactor	1.Material incompatibility hazard may arise 2.Overflow from reactor	1.PM of the reactor is performed as per predefine schedule. 2.Spark test is performed before start up.	3	3	9				
11	Compositio n	Other than	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.N2 blanketing to be continue while drum charging. 4.Tantalum plug is provide in the reactor.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	DG power backup is provided to the reactor.	3	1	3				
		Instrument Air Failure	Air compressor failure	Temperature rise may possible in the reactor	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of dry HCl charging line ROV is to be air failed to closed condition.	3	3	9				
		Agitation	Agitator decoupled	Exotherm may possible	1.No load tripping is provided on agitator. 2.Agitator running indication is provided on DCS. 1.Recommend to provide interlock to closed dry HCl	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					purging line XV incase of agitator stop/trip.							
Stream-3		**EO addition in EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
13	Quantity/Flow	Low/Less	Human error (Bottom manual valve of EO day tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (manual valve of EO receiving line on EO coupling reactor not opened).	Transferring line may pressurise	1.Line design pressure is sustain to maximum pressure.	3	3	9				
			Low pressure of N2 in EO day tank	No HSE hazard/Process Delay	1.PT is available in day tank with low and low low alarm.	3	1	3				
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Fire extinguisher and fire hydrant point is provided in near by area. 3. Flange guard is provided on all flanges. 4.Compatible gasket	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/04/2017			
Node 2		Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					issued. 5.All electrical installation as per HAC classification. 6.EO detector is provided on absorption reactor and also indication provided on DCS with alarms and local flameproof hooter. 7. interlock is provided to closed EO addition line FCV & ROV at HH value of EO detector. 8.Flash alarm is provided on HH value of EO detector.							
			Low level in EO day tank(2KL)	No HSE hazard/Process Delay	1.Flow meter is available in addition line . 2.Loadcell is available in EO day tank with alarms.	3	1	3				
			Flow meter malfunctioning/choked	No HSE hazard/Process Delay	1.Flow meter PM to be performed before start the operation. 2. Choking not possible.	3	1	3				
			FCV of EO addition line stuck	No HSE hazard/Process Delay	PM of FCV is performed as per schedule.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 3. TI is available in the reactor with high and high high alarms. 4. CHBS provision is available in jacket of the reactor to control temperature. 5.flow meter and totaliser upper limit is freez as per process requirement. 6.Interlock is provided to closed EO addition line CV & ROV at HH temperature of the absorption reactor. 3.Flash alarm is provided on HH value of TI of the absorption reactor.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
			FCV of EO addition line stuck		1.PM of FCV is performed as per schedule. 2.XV is also available in EO addition line.	3	4	12				
		Mis-directed										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		flow										
		Low	No probable cause									
			Refer high flow									
14	Pressure	High	Reactor vent/Vapor line valve closed (Human error)	Reactror may pressurise and gas generation may possible	1.PT is provided in the absorption reactor with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Interlock is provided to closed EO addition line CV & ROV at HH pressure of the reator. 2.Flash alarm to be provide on HH pressure of the reactor.	3	4	12				
			Scrubber failure		1.scrubber circulation pump indication is available on DCS. 2.Interlock is provided to closed the EO addition CV & ROV incase of scrubber circulation pump trip/stop.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utiity(chilling brine) circulation failure		1.Brine circulation pump running indication is available on DCS. 2.TI is provided in utility supply and return line of the absorption reactor. 3.Interlock is provided to closed EO addition line CV & ROV incase of brine pump circulation pump trip/stop. 4.Flash alarm is provided incase of brine plant circulation pump trip/stop.	3	4	12				
15	Temperatur	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	e	High	Fast addition rate of EO	Exotherm and gas generation may possible	1.Flow meter, ROV and CV is available in addition line. 2.Orifice is also available in EO addition line. 3.Addition line Flow meter maximum rate is fixed at 130 kg/hr. 4.Interlock is provided to closed the addition line ROV in case of scrubber circulation pump trip/stop. 5.EO Addition line ROV is closed at HH temperature of the reactor. 6.Flash alarm is provided on HH temperature of the reactor.	3	4	12				
			More quantity of EO charged		1.Flow meter, ROV and CV is available in addition line. 2.Orifice is also available in EO addition line. 3.Totaliser upper limit is freezed as per process requirement. 4.Interlock is provided to closed the addition line ROV in case of scrubber circulation pump trip/stop.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.Addition line ROV is closed at HH temperature of the reactor.							
			Parallel material charging of EO &Dry HCl inplace of series		1.Trained manpower is deputed for operation. 2.SOP is available . 3.At a time only one ROV will be open from 2CE mass , EO addition and dry HCl gas.	3	4	12				
			Brine plant pump circulation stop/Trip		1.TI is available with high and high high alarm. 2.Interlock is provided to stop the EO addition ROV when brine plant pump circulation stop. 3.Flash alarm is provided incase of brine plant circulation pump trip/stop.	3	4	12				
			TI malfunction		PM of RTD is performed as per predefine schedule.	3	4	12				
16	Level	Low	Refer low flow									
			Refer high flow									
		High	Jacket puncture of the reactor	1.Material incompatiblity hazard may arise 2.Overflow from	1.PM of the reactor is performed as per predefine schedule. 2.Spark test is performed before start up.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				reactor								
17	Compositio n	Other than										
18	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.N2 blanketing to be continue while drum charging. 4.Tantalum plug ia provied in the reactor.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	DG power backup is provided to the reactor.	3	1	3				
		Instrume nt Air Failure	Air compressor failure	No HSE hazard	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of EO addition line ROV & CV is to be air failed to closed condition.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled	Exotherm may possible	1.No load tripping is provided on agitator. 2.Agitator running indication is provided on DCS. 3. interlock is provided to closed EO addition line ROV & CV incase of agitator stop/trip.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**2CE absorption mass transferring in storage tank from EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before startup. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1.Flange guard to be provide on the flanges.	2	3	6
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in absorption reactor	No HSE hazard/Process Delay	No existing safeguard	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(manual vent line valve is closed)	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Flash alarm is provided on high high value of PT of tank. 5.Vent line valve of storage tank is locked open condition with tagging.	3	4	12				
		High/More	Human error(withdrawal not done regularly)	Tank may overflow	1.Trained manpower is deputed for operation. 2.Loadcell is available in tank with high and high high alarms. 3.Level switch is available in storage tank. 4.Flash alarm is provided on high high value of Loadcell of storage tank. 5.Flash alarm is provided on LSH activation.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
		High	Human error(manual vent line valve is closed)	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Flash alarm is provided on high high value of PT of tank.	3	4	12				
			N2 line PRV failure		1.Local vent is provided in the tank. 2. PT is available to monitor the pressure of tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.PM of PRV is performed as per predefine schedule. 5.N2 line maximum pressure is 1.5kg/cm2. 6.Rotameter is provided in N2 line for inertisation.	3	4	12				
3	Temperature	Low	No probable cause									
		High	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1. PM of tank is performed before start up and as per predefine schedule. 2. Pressure test is performed before start-up. 3. Loadcell is available in tank with low and low low alarm	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to storage tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power	GEB power	No HSE	Two numbers of DG is	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Failure	failure	hazard	available for power backup.							
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from 2CE absorption mass storage tank(011ST-035/036) to distillation column(011CM-018) through feeding pump (011TP-130/131)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line. 3.Pump running indication is provided on DCS. 4.Interlock is provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in nearby area. 6.All electrical equipment are flameproof in nearby area. 7. Spill kit is provided in the	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					nearby area to contain spillage.							
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area. 3.Double valve/blind is provided to prevent valve passing/leakage. 4.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provide on high high value of LI of column.	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	2	6				
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (011CM-018)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the CV & XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 25/04/2017			
Node 4		Node Description : 011CM-018 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the column. 8. Flash alarm is provided at HH temperature and HH pressure of the column.							
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2. PT is available in distillation column with high and high high alarm. 3.At HH pressure of top and bottom of the column reboiler steam TCV is closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 4..Flash alarm is provided on HH pressure of top and bottom of the column.	3	4	12				
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					water circulation pump indication is also available on DCS. 3.PT is also available in cooling tower pump discharge line with low and low low alarms. 4.TI is provided in vapour line from primary to secondary condenser line. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump is stop. and also bottom collection CV is closed.							
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					column with high and high high alarms. 5.TCV stroke testing is carried out as per define schedule. 6.Flash alarm is provided on HH temperature of top and bottom of the column. 7.Interlock is provided that at HH temperature of top & bottom of the column steam TCV is closed and same time bottom collection CV is closed.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top, middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm. 3.Interlock is provided that in case of bottom withdraw pump trip/stop than steam TCV to be closed. 4.Interlock is provided that at HH value of LI of column feeding pump to be stop.	3	1	3				
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS. 3.CV stroke testing is carried out as per defined	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					PM schedule.							
			Human error (steam TCV is not open)		1.steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so, no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.steam TCV air fail safe position is air failed to close. 4.Distillation column top collection & bottom collection CV air fail safe position is air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-3		**Top collection in pure 2CE receiver(010TK-255) & distilled 2CE receiver(010TK-256)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	2.Double valve/blind provision to prevent valve passing/leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in distillation	No HSE hazard/Proces	LI is available in sump of the distillation column with	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			column	s Delay	low and low low alarm.							
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump is stop. and also bottom collection CV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	1.Control valve stroke testing is carried out as per PM schedule.	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vent line valve is not open of 2CE receiver	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation and ensure vent line valve is open before startup. 3.Tank design pressure is up to 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	4	12				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.Steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so, there are no chances of incompatibility hazard. 5.LSH is also available in collection tank. 6.Flash alarm is provided on high high value of Loadcell & level switch activation of receiver. 7. interlock is provided to closed top collection line CV at HH value of loadcell & LSH activation.	3	3	9				
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.Interlock is provided that at HH temperature of top of the column steam TCV is closed and same time feeding pump and bottom withdraw pump is stop and top & bottom collection CV is closed.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
		Low	No probable cause									
14	Pressure	High	Human error (Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms. 3.Vent line valve is made available in critical locked open condition and tag to be provide on valve. 4. Flash alarm is provided at HH pressure of tank.	3	4	12				
15	Temperature	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms. 4. Spill kit is provided in the nearby area to contain spillage. 5.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9		2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal taken in CM-018 & 066 bottom withdrawal tank (010ST-212)**										
19	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms. 3.Flash alarm is provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time steam TCV, bottom collection line CV to be closed.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/04/2017			
Node 4		Node Description : 011CM-018 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	2.Double valve provision is available to prevent valve passing/leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in distillation	No HSE hazard/Proces	LI is available in sump of the distillation column with	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			column	s Delay	low and low low alarm.							
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay	CV stroke testing is carried out as per PM schedule.	3	3	9				
			Human error(Vent line valve is not open)	Tank may pressurize	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.Flash alarm on HH value of PT of the tank.	3	4	12				
			Flow meter malfunction	Process delay	1.Loadcell is available in bottom collection receiver to monitor the level. 2. Flow meter PM is done periodically.	3	1	3				
		High/More	Bottom collection CV passed	Overflow may possible	1.Loadcell is available in bottom collection receiver with high and high high alarm. 2.Interlock is provided that at HH value of Loadcell of receiver bottom collection CV to be closed. 3.Flash alarm is provided on	3	3	9				
			Bypass valve of CV passed/left open									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					HH value of loadcell of the bottom collection receiver.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. Receiver design pressure is 6 bar. 3.PT is available in tank with high and high high alarm. 3.Vent line valve is made available in critical locked open condition and tag to be provide on valve. 4.Flash alarm is provided on HH value of PT of the bottom collection tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.Interlock to closed bottom collection line CV at HH value of PT of the bottom collection tank.							
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	No HSE hazard								
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2.Loadcell is available in the tank with low and low low alarms. 3. Spill kit is provided in the nearby area to contain spillage. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/04/2017**			
Node 4		**Node Description : 011CM-018 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Bottom collection line CV air failed safe position is to be air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from 2CE absorption mass storage tank(011ST-035/036) to distillation column(021CM-066) through feeding pump (011TP-130/131)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line. 3.Pump running indication is provided on DCS. 4.Interlock is provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area. 3. double valve/blind provision is prevent valve passing/leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.							
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit to is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	2	6				
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperatur	Low	No probable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	e		cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrume nt Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (021CM-066)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the CV & XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the column. 8. Flash alarm is provided at HH temperature and HH pressure of the column.							
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2. PT is available in distillation column with high and high high alarm. 3.At HH pressure of top and bottom of the column reboiler steam TCV is closed and at a same time feeding pump is stop and bottom collection CV to be closed. 4..Flash alarm is provided on HH pressure of top and bottom of the column.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 3.PT is also available in cooling tower pump discharge line with low and low low alarms. 4.TI is provided in vapour line from primary to secondary condenser line. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump to be stop. and also bottom collection CV to be closed.	3	4	12				
9	Temperature	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms. 5.Flash alarm is provided on HH temperature of top and bottom of the column. 6.Interlock is provided that at HH temperature of top & bottom of the column steam TCV is closed and same time bottom collection CV is closed.	3	3	9				
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation. 22.TCV bypass valve is locked closed condition with tagging.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top, middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm. 3.Interlock is provided that in case of bottom withdraw pump trip/stop than steam TCV to be closed. 4.Interlock is provided that	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					at HH value of LI of column feeding pump to be stop.							
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS. 3.CV stroke testing is carried out as per defined PM schedule.	3	1	3				
			Human error (steam TCV is not open)		1.steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	3	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so, no chances of incompatible hazard.	3	3	6				
11	Compositio n	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.steam TCV air fail safe position is air failed to close. 4.Distillation column top collection & bottom collection CV air fail safe position is air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-3		**Top collection in collection receiver(013TK-340)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Double valve/blind provision is available to prevent valve passing/leakage.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump is stop. and also bottom collection CV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	1.Control valve stroke testing is carried out as per PM schedule.	2	1	2				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vacuum balancing line valve is not open	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation and ensure vent line valve is open before startup. 3.Tank design pressure is up to 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.Steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	2	1	2				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available in collection receiver with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so, there are	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					no chances of incompatibility hazard. 5.Flash alarm is provided on high high value of LI of collection receiver. 6.Interlock is provided to closed top collection line CV at HH value of LI of receiver.							
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV is closed and same time feeding pump and bottom withdraw pump is stop and top & bottom collection CV is closed.	3	4	12				
		Reverse	No probable cause									
		Mis-directed	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		flow										
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not open	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation and ensure vent line valve is open before startup. 3.Tank design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	4	12				
15	Temperature	Low	No probable cause		TI is available in collection receiver							
		High	No probable cause		TI is available in collection receiver							
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3.LI is available in the collection receiver with low and low low alarms. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal taken in CM-018 & 066 bottom withdrawal tank (010ST-212)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
19	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms. 4.Flash alarm is provided on HH value of LI of sump of distillation column. 5.Interlock is provided that if bottom withdrawal pump stop/trip than at same time steam TCV, bottom collection line CV is closed.	3	3	9				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7.Line is design to resist	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					maximum discharge pressure of pump. 8. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Double valve is provided to prevent valve passing/leakage.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	3	1	3				
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay	CV stroke testing is carried out as per PM schedule.	3	3	9				
			Human error(Vent line valve is not open)	Tank may pressurize	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 25/06/2017			
Node 5		Node Description : 021CM-066 (Continuous Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					upto 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.							
			Flow meter malfunction	Process delay	1.Loadcell is available in bottom collection receiver to monitor the level. 2.Flow meter PM is done periodically.	3	1	3				
		High/More	Bottom collection CV passed	Overflow may possible	1.Loadcell is available in bottom collection receiver with high and high high alarm. 2.Interlock is provided that at HH value of Loadcell of receiver bottom collection CV is closed. 2.Flash alarm is provided on HH value of loadcell of the bottom collection receiver.	3	3	9				
			Bypass valve of CV passed/left open									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. Receiver design pressure is 6 bar. 3.PT is available in tank with high and high high alarm. 4.Flash alarm is provided on HH value of PT of the bottom collection tank. 5.Interlock is provided to closed bottom collection line CV at HH value of PT of the bottom collection tank.	3	4	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	2	4	8
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	No HSE hazard								
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2.Loadcell is available in the tank with low and low low alarms. 3. Spill kit is provided in the nearby area to contain spillage. 4.Equipment thickness	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					testing is carried out as per define schedule.							
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Bottom collection line CV air failed safe position is to be air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-5		**Top collection receiver (013TK-340) unloading in pure 2CE receiver(020ST-210) & Distilled 2CE receiver(020ST-211)**										
25	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Interlock is provided that at HH pressure of the tank transferring line ROV is closed. 4.Flash alarm is provided at HH value of PT of the storage tank.	3	4	12				
		High/More	Loadcell malfunctioning in both collection tank	Tank may overflow	1.PM of Loadcell is performed as per predefine schedule. 2.LSH is available in tank with high and high high alarm. 3.Interlock is provided that transferring line ROV is closed in case of LSH activation. 4.Flash alarm is provided in case of LSH activation.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			LSH malfunctioning in both collection tank		1.PM of LSH is performed as per predefine schedule. 2.Loadcell is available in tank with high and high high alarm. 3.Interlock is provided that transferring line ROV is closed incase of HH value of loadcell of the tank. 4.Flash alarm is provided incase of HH value of Loadcell of the tank.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
26	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Interlock is provided that at HH pressure of the tank transferring line ROV is closed. 4.Flash alarm is provided at	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					HH value of PT of the storage tank.							
27	Temperature	Low	No probable cause									
		High	No probable cause									
28	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage. 2.ROV is also available in line.	3	3	9				
		High	Refer high Flow									
29	Composition	Other than	No probable cause									
30	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 25/06/2017**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					near by area. 3.All electrical equipment are flameproof in near by area. 4. Earthing continuity is verified before start-up.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.2CE mass transferring line ROV air failed safe position is to be air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CM-018 & 066 bottom withdrwal transfer to CEE pure distillation reactor(011RT-042)**										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 4.Flange guard is provided on the flanges. 5.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:-26/04/2017			
Node 6		Node Description : CEE pure distillation reactor(011RT-042)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Storage tank vent valve is closed(CM-018 &066 bottom withdrawal tank)	Tank may implode	1.PT available in the tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at LL value of PT of the storage tank. 5.Flash alarm is provided to LL value of PT of the storage tank. 6.Vent line valve is locked open condition with tagging.	3	3	9				
			Low level in storage tank	No HSE hazard/Process Delay	1.Loadcell is available in tank to monitor the level of tank.	3	1	3				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup.	3	3	9				
		High/More	No credible cause									
		Reverse	Pump trip/stops	Pump mechanical damage	NRV to be provide in the pump discharge line to prevent reverse flow.	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent line valve is closed)	Reactor may pressurise	1.PT is available in tank with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation. 4..Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at HH value of PT of CEE pure distillation reactor. 5.Flash alarm is provided on HH value of PT of CEE pure distillation reactor.	3	4	12				
3	Temperature	Low	No credible cause		TI is available in reactor.							
		High	No credible cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Refer low Flow									
		High	Refer high Flow									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is air failed to close condition. 4.Interlock is provided to stop the transferring pump when transferring line XV is closed.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due	No HSE hazard/Proces								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			to mechanical failure	s Delay								
Stream-2		**Pure CEE distillation in CEE pure distillation reactor(011RT-042)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
		High Vacuum	No probable cause	No HSE hazard								
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 6. Interlock is provided to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					stop steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature of the reactor. 8. Flash alarm is provided at HH temperature of the reactor.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provide to prevent valve passing. 5.Spill kit is provided in the nearby area to contain spillage.	3	3	9				
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe position is air fail to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					close. 5.ROV of vacuum line air fail safe position is air fail to open.							
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping is provided. 2.steam TCV is closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Collection of pure/mix CEE in receiver(012TK-086 & 012TK-087)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:-26/04/2017			
Node 6		Node Description : CEE pure distillation reactor(011RT-042)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					spillage.							
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in distillation column	No HSE hazard/Process Delay	1.Batch wise fixed quantity material is charged into reactor before start distillation.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.At HH temperature of final	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:-26/04/2017			
Node 6		Node Description : CEE pure distillation reactor(011RT-042)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					vent line steam TCV is closed. 8.Interlock is provided that if all circulation pump of cooling water and chilling water is stop than steam TCV to be closed.							
			Top collection line CV stuck	No HSE hazard	CV stroke testing is carried out as per predefine schedule.	3	1	3				
			Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for up to 6 bar pressure.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	3	1	3				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Flow meter is available in reflux line and collection line with high and high high alarms.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Compatible utility is used in condenser .so, there are no chances of incompatibility hazard.							
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for up to 6 bar pressure.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver with low and low low alarms. 4. Spill kit is provided in the nearby area to contain spillage. 5. Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Top collection receiver (012TK-086) unloading in pure 2CE receiver(010TK-255) & Distilled 2CE receiver(010TK-256)**										
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:-26/04/2017			
Node 6		Node Description : CEE pure distillation reactor(011RT-042)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area. 7. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for up to 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank.	3	4	12				
		High/More	Loadcell malfunctioning in both collection tank	Tank may overflow	1.PM of Loadcell is performed as per predefine schedule. 2.LSH is available in tank with high and high high alarm. 3.Flash alarm is provided in case of LSH activation.	3	3	9				
			LSH		1.PM of LSH is performed	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			malfunctioning in both collection tank		as per predefine schedule. 2.Loadcell is available in tank with high and high high alarm. 3.Flash alarm is provided incase of HH value of Loadcell of the tank.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for up to 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank.	3	4	12				
21	Temperature	Low	No probable cause									
		High	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
22	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3. Equipment thickness testing is carried out before startup. 4. Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:-26/04/2017**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 26/04/2017			
Node 7		Node Description : 2CE distillation reactor(011RT-158)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		CM-018 & 066 bottom withdrwal transfer to 2CE distillation reactor(011RT-158)										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 4.Flange guard is provided on the flanges. 5.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			Title : 2CE						Plant Name: Plant-1 Date:- 26/04/2017			
Node 7		Node Description : 2CE distillation reactor(011RT-158)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Storage tank vent valve is closed(CM-018 &066 bottom withdrwal tank)	Tank may implode	1.PT available in the tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at LL value of PT of the storage tank. 5.Flash alarm is provided to LL value of PT of the storage tank. 6.Vent line valve is locked open condition with tagging.	3	3	9				
			Low level in storage tank	No HSE hazard/Process Delay	1.Loadcell is available in tank to monitor the level of tank.	3	1	3				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup.	3	3	9				
		High/More	No credible cause									
		Reverse	Pump trip/stops	Pump mechanical damage	NRV to be provide in the pump discharge line to prevent reverse flow.	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent line valve is closed)	Reactor may pressurise	1.PT is available in tank with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at HH value of PT of CEE pure distillation reactor. 5.Flash alarm is provided on HH value of PT of CEE pure distillation reactor.	3	4	12				
3	Temperature	Low	No credible cause		TI is available in reactor.							
		High	No credible cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Refer low Flow									
		High	Refer high Flow									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is air failed to close condition. 4.Interlock is provided to stop the transferring pump when transferring line XV is closed.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due	No HSE hazard/Proces								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			to mechanical failure	s Delay								
Stream-2		**Distillation in 2CE distillation reactor(011RT-158)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
		High Vacuum	No probable cause	No HSE hazard								
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					stop steam line TCV at HH temperature and HH pressure of the reactor. 7. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error (TCV bypass line passed/open)		1.TCV bypass valve should be locked closed condition with tagging.	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.							
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe position is air fail to close. 5.ROV of vacuum line air fail safe position is air fail to open.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.steam TCV to be closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Collection of pure/mix cut 2CE in receiver(013TK-344 & 013TK-345)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			No/low level in distillation column	No HSE hazard/Process Delay	1.Batch wise fixed quantity material is charged into reactor before start distillation.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.At HH temperature of final vent line steam TCV is closed. 8. Interlock is provided that if all circulation pump of cooling water and chilling water is stop than steam TCV to be closed.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Top collection line CV stuck	No HSE hazard	CV stroke teating is carried out as per predefine schedule.	3	1	3				
			Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	3	1	3				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Flow meter is available in reflux line and collection line with high and high high alarms. 3.Compatible utility is used in condenser .so, there are no chances of incompatibility hazard. 4.LI is available in collection receiver with high and high high alarm.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 26/04/2017			
Node 7		Node Description : 2CE distillation reactor(011RT-158)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					5.Flash alarm is provided on HH value of LI of the receiver. 6.Interlock is provided to closed top collection line CV at HH value of LI of top collection receiver.							
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			open		receiver. 3.Receiver design for upto 6 bar pressure. 4.PT is available in collection receiver with high and high high alarm. 5.Flash alarm is provided on HH value of PT of the receiver. 6.Interlock is provided to closed top collection line CV at HH value of PT of top collection receiver.							
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg. C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver with low and low low alarms. 4. Spill kit is provided in the nearby area to contain spillage. 5.Equipment thickness	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					testing is carried out as per define schedule.							
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Not applicable									
Stream-4		**Top collection receiver (013TK-344) unloading in CM-018 & 066 bottom withdrawal tank(010ST-212)**										
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5.Interlock is provided to closed transferring line ROV at HH value of PT of tank.							
		High/More	Human error (withdrawal not done at regularly)	Tank may overflow	1.Loadcell is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation. 3.Flash alarm is provided at HH value of loadcell of storage tank. 4. interlock is provided to closed transferring line XV at HH value of loadcell of storage tank.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5. interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				
21	Temperature	Low	No probable cause		TI is available in tank.							
		High	No probable cause		TI is available in tank with high and high high alarm.							
22	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve		1.Triple manual valve is	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			pass/leakage		available to prevent valve passing/leakage.							
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of 2CE transferring line XV is air failed to closed condition with tagging.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Not applicable									
Stream-5		**Top collection receiver (013TK-345) unloading in CEE pure storage reactor(011RT-159)**										
25	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on reactor is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve of reactor is not opened)	Reactor may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 26/04/2017			
Node 7		Node Description : 2CE distillation reactor(011RT-158)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3.Reactor is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage reactor. 5.interlock is provided to closed transferring line ROV at HH value of PT of storage reactor.							
		High/More	Human error(withdrwal not done at regularly)	Reactor may overflow	1.LI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation. 3.LSH is also provided in storage reactor. 4.Flash alarm is provided at HH value of LI & LSH activation of storage reactor. 5.Interlock is provided to closed transferring line XV at HH value of LI &LSH activation of storage reactor.	3	3	9				
		Reverse	No probable cause									
		Mis-directed	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 26/04/2017			
Node 7		Node Description : 2CE distillation reactor(011RT-158)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		flow										
26	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve of reactor is not opened)	Reactor may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Reactor is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage reactor. 5.Interlock is provided to closed transferring line ROV at HH value of PT of storage reactor.	3	4	12				
27	Temperature	Low	No probable cause		TI is available in tank.							
		High	No probable cause		TI is available in tank with high and high high alarm.							
28	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1 Date:- 26/04/2017			
Node 7		Node Description : 2CE distillation reactor(011RT-158)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					startup. 4.LI is available to monitor the level of the storage reactor.							
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
29	Composition	Other than	No probable cause									
30	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of 2CE transferring line XV is air failed to closed condition with tagging.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CM-018 & 066 bottom withdrawal transfer to 2CE distillation reactor(021RT-155)**										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 4.Flange guard is provided on the flanges. 5.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Storage tank vent valve is closed(CM-018 &066 bottom withdrwal tank)	Tank may implode	1.PT available in the tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at LL value of PT of the storage tank. 5.Flash alarm is provided to LL value of PT of the storage tank. 6.Vent line valve is locked open condition with tagging.	3	3	9				
			Low level in storage tank	No HSE hazard/Process Delay	1.Loadcell is available in tank to monitor the level of tank.	3	1	3				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup.	3	3	9				
		High/More	No credible cause									
		Reverse	Pump trip/stops	Pump mechanical	NRV to be provide in the pump discharge line to	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				damage	prevent reverse flow.							
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent line valve is closed)	Reactor may pressurise	1.PT is available in tank with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at HH value of PT of CEE pure distillation reactor. 5.Flash alarm is provided on HH value of PT of CEE pure distillation reactor.	3	4	12				
3	Temperature	Low	No credible cause		TI is available in reactor.							
		High	No credible cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Refer low Flow									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is air failed to close condition. 4. interlock is provided to stop the transferring pump when transferring line XV is closed.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		**Distillation in 2CE distillation reactor(021RT-155)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to stop the XV & CV of vacuum line in case of	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
		High Vacuum	No probable cause	No HSE hazard								
9	Temperature	Low	No probable cause	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.							
			Human error(TCV bypass line passed/open)		1.TCV bypass valve should be locked closed condition with tagging.	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit is provided in the nearby area to contain	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					spillage.							
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe position is air fail to close. 5.ROV of vacuum line air fail safe position is air fail to open.	3	4	12				
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due	Runaway may possible	1.Agitator no load tripping to be provided.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			to mechanical failure		2.steam TCV to be closed in case of agitator stop/trip.							
Stream-3		**Collection of pure/mix cut 2CE in receiver(013TK-341 & 013TK-342)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in distillation	No HSE hazard/Proces	1.Batch wise fixed quantity material is charged into	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			column	s Delay	reactor before start distillation.							
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.At HH temperature of final vent line steam TCV is closed. 8.Interlock is provided that if all circulation pump of cooling water and chilling water is stop than steam TCV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	CV stroke teating is carried out as per predefine schedule.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	3	1	3				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Flow meter is available in reflux line and collection line with high and high high alarms. 3.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard. 4.LSH is available in collection receiver. 5.Interlock is provided to provide flash alarm on LSH activation of the receiver. 6.Interlock is provided to	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					closed top collection line CV at LSH activation of the receiver.							
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provide on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for up to 6 bar pressure. 4.PT is available in	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					collection receiver with high and high high alarm. 5.Flash alarm is provided on HH value of PT of the receiver. 6. interlock is provided to closed top collection line CV at HH value of PT of top collection receiver.							
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3.Spill kit is provided in the nearby area to contain spillage. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Top collection receiver (013TK-341) unloading in pure 2CE receiver(020ST-210) & Distilled 2CE receiver(020ST-211)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5.Interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				
		High/More	Human error (withdrawal not done at regularly)	Tank may overflow	1.Loadcell is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation. 3.LSH is also available in storage tank. 4.Flash alarm is provided at HH value of loadcell of storage tank. 5.Interlock is provided to closed transferring line XV at HH value of loadcell of storage tank. 6.Interlock is provided to	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					closed transferring line ROV at LSH activation of storage tank. 7.Flash alarm is provided on LSH activation of storage tank.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
		Low	No probable cause									
20	Pressure	High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5.Interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				
21	Temperature	Low	No probable cause		TI is available in tank.							

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause		TI is available in tank with high and high high alarm.							
22	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1 Date:- 26/04/2017**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					verified before start-up.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of 2CE transferring line XV is air failed to closed condition with tagging.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

---- END OF THE REPORT -----

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HAZOP -2CE						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)	Pure 2CE mass charging in EO + 2CE absorption reactor(013RT-038) from 2CE pure storage tank(010TK-255) &(010TK-256)	Flange guard to be provided in transferring line.	Mechanical	Completed	1
2			Blind to be provided to all drain point open end flanges.	Mechanical	Completed	2
3	2CE absorption mass storage tank(011ST-035/011ST-036)	2CE absorption mass transferring in storage tank from EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)	Flange guard to be provide on the flanges.	Mechanical	Completed	3
4	011CM-018 (Continous Distillation Column)	Continuous distillation in distillation column (011CM-018)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	4
5	021CM-066 (Continous Distillation Column)	Bottom withdrawal taken in CM-018 & 066 bottom withdrwal tank (010ST-212)	Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Mechanical	Completed	5
6	CEE pure distillation reactor(011RT-042)	Pure CEE distillation in CEE pure distillation reactor(011RT-042)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	6

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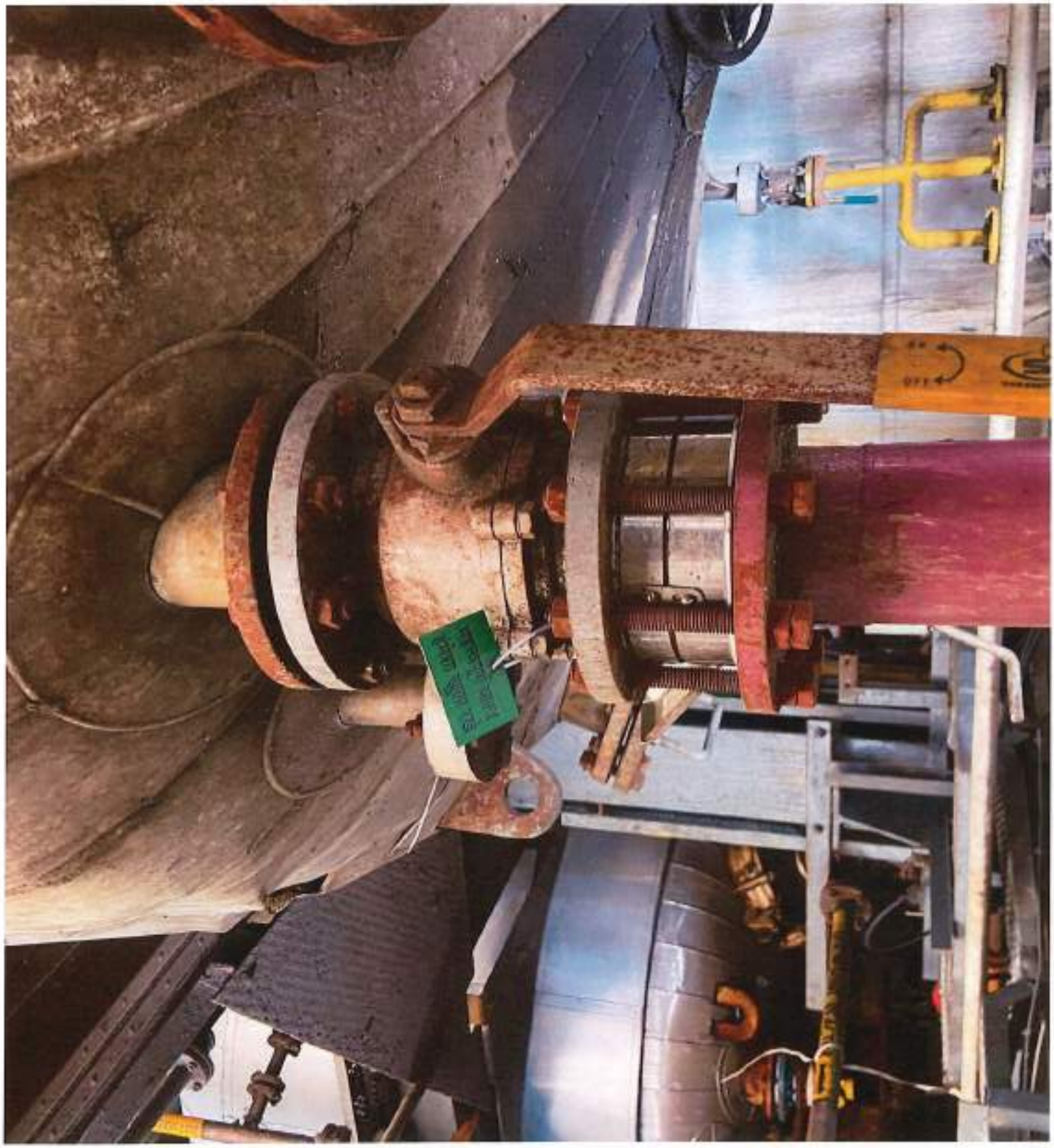
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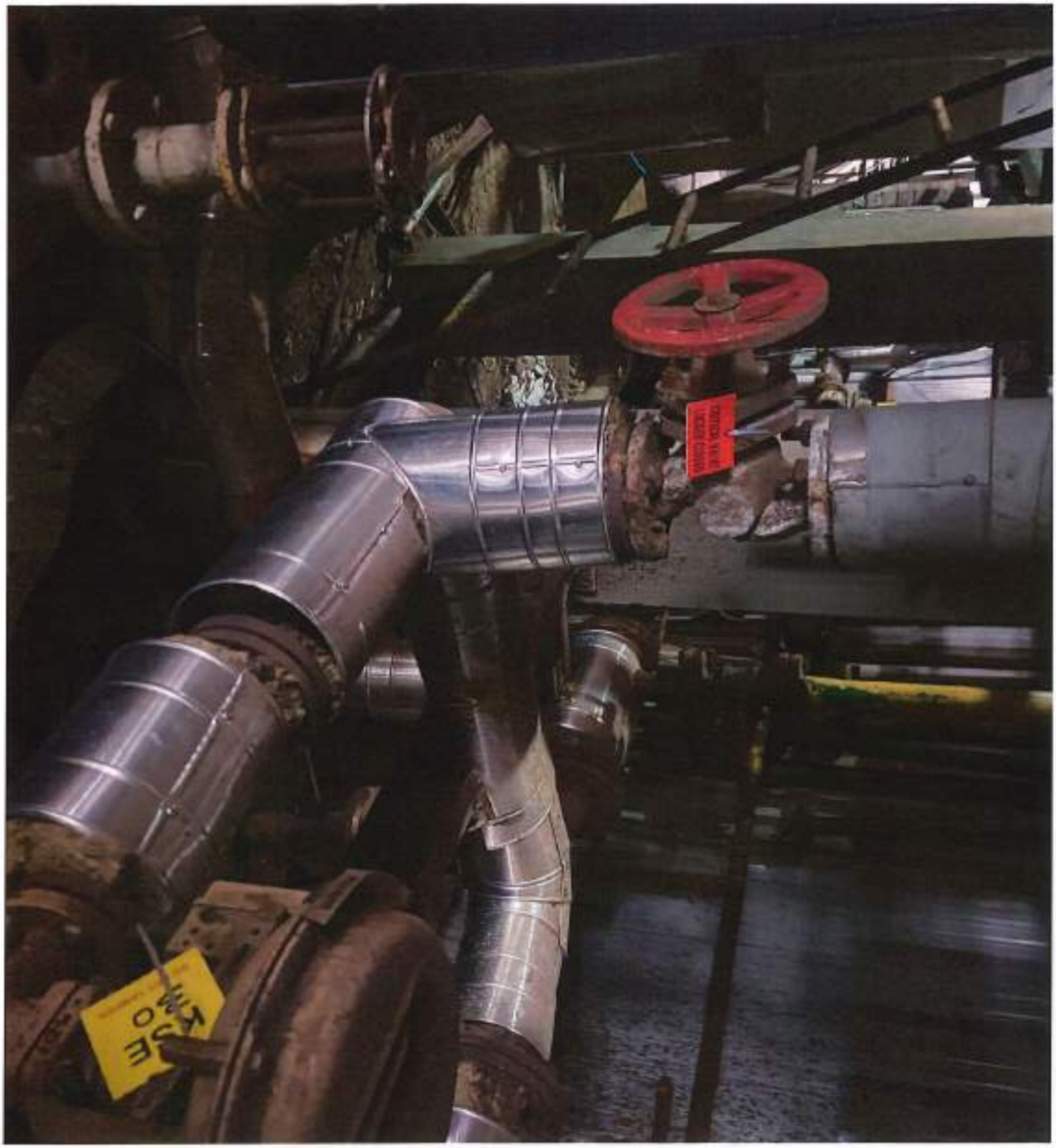
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HAZOP STUDY REPORT OF

DRY HCL PLANT

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

JUNE 2017

aether
elementally innovative



NEXA
Process Safety Engineers

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8203 SITE, SACHIN, SURAT

HAZOP STUDY REPORT OF

DRY HCL PLANT

JUNE 2017

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

05/06/2017

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Dry HCL Plant.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for Dry HCL Project. It has 5 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	CaCl2 Dosing reactor(012RT-176)
2.	30%HCl CM-084 feed tank(030ST-006)
3.	CaCl2 KOD column-102(010CM-085)
4.	Distillation Column(010CM-084)
5.	Scrubber System(010TK-347)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel,

examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	**2**	**3**	**4**	**5**
Severe	**5**	**5**	**10**	**15**	**20**	**25**
Significant	**4**	**4**	**8**	**12**	**16**	**20**
Serious	**3**	**3**	**6**	**9**	**12**	**15**
Moderate	**2**	**2**	**4**	**6**	**8**	**10**
Minor	**1**	**1**	**2**	**3**	**4**	**5**
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

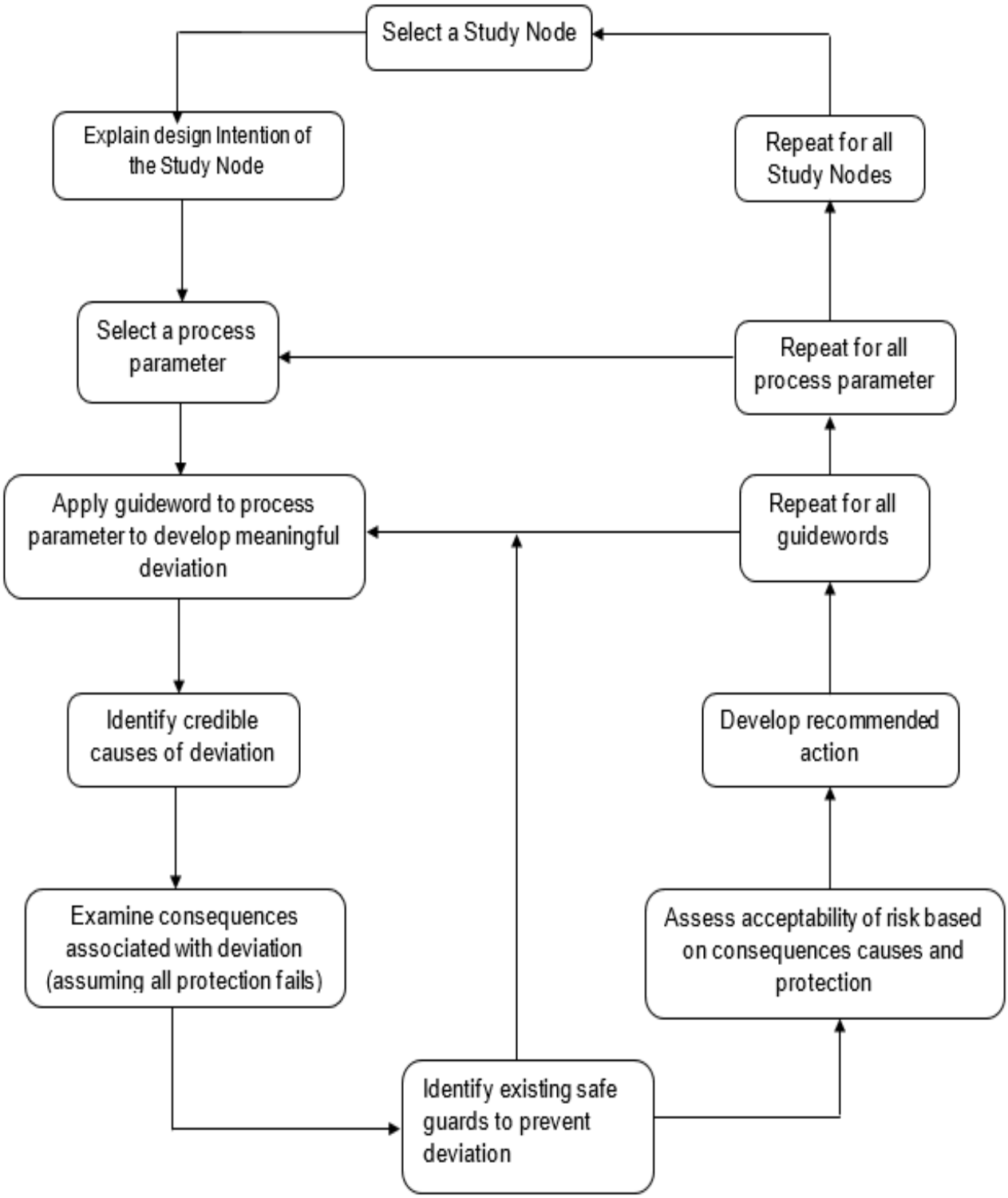
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	GL/36422/22

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that

suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

DRY HCl HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	CaCl2 Dosing reactor(012RT-176)	Water charging in CaCl2 Dosing reactor(012RT-176)	Vent line valve should be locked open with tagging.	Mechanical
2	CaCl2 KOD column-	CaCl2 transfer in cacl2 KOD column(010CM-	Flange guard to be provided in all the flanges.	Mechanical

DRY HCl HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
3	102(010CM-085)	085) by cacl2 dosing tank (012RT-176) by gravity	TCV bypass valve should be locked closed condition with tagging.	Mechanical
4	Distillation Column(010CM-084)	Heating , maintaining and CaCl2 circulation in distillation column(010CM-084)	TCV bypass valve should be locked closed condition with tagging.	Mechanical
5	Scrubber System(010TK-347)	Reaction in scrubber tank (010TK-347)	Pump discharge valve should be critical locked open condition and tag to be provide on that.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please

refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 1		Node Description : CaCl2 Dosing reactor(012RT-176)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Water charging in CaCl2 Dosing reactor(012RT-176)										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow.	2	2	4				
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurize	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in reactor to monitor the pressure of the reactor. 3.Reactor design pressure is upto 6 bar.	3	4	12	1. Vent line valve should be locked open with tagging.	2	4	8
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Trained man power is deputed for DCS operation. 2.Upper limit of totaliser is freeze as per process requirement. 3.Interlock is provided to closed the water transferring line ROV at set value achieved in totaliser.	3	2	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunction		1.Flow meter PM is performed as per predefined schedule.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in reactor to monitor the pressure of the reactor. 3.Reactor design pressure is upto 6 bar.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left open/pass	No HSE hazard	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
			Refer High/More flow									
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
5	Composition	Other than	No probable cause	No HSE hazard								
		Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Water transferring line XV air failed safe position is to be air failed to closed condition .	3	3	9				
6	Others	Power Failure	-	No HSE hazard								
		DCS Failure	-	No HSE hazard								
		Agitation	-	No HSE hazard								
Stream-2		**CaCl2 charging in CaCl2 dosing reactor(012RT-176)**										

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Human error (Less quantity of CaCl2 charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	3	1	3				
		High/More	Human error (More quantity of CaCl2 charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
			No probable cause									
9	Temperature	Low	No credible cause									
		High	Human error(Material is charge by more rate)	Temperature rise may possible in the dosing reactor	1.Trained manpower is deputed for operation. 2.TI is available in the reactor with high and high high alarm. 3.Cooling water supply provision is available in the dosing reactor. 4.Flash alarm is provided on HH value of TI of the reactor.	3	4	12				
10	Level	Low	Refer low Flow									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
11	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may arrise	1.Material issue slip is verified by plant person. 2.Checklist is filled and verified by product person and ensure actual material is charged in process.	3	3	9				
12	Others	Static charge	No credible cause									
		Leakage spillage		No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in the dosing reactor	1.Agitator running indication is provided on DCS. 2.No load tripping is provided on agitator.	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**30%HCl charging in CM-084 feed tank(011TK-318) from storage tank(030ST-006)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	2	4				
			Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	2	1	2				
			Line leakage	Health hazard due to spillage	1.Line pressure testing is performed before start up. 2.Spillage kit is provided in near by area.	2	2	4				
			No level in HCl tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available in tank.	3	1	3				
		High/More	Human error (Wrong input in totaliser)	Receiver may overflow	1.Trained manpower is deputed for operation 2.LI is available in receiver with high and high high alarm. 3.upper limit of totaliser is freez for HCL. 4. Interlock is provided to stop the transferring pump and closed transferring line XV at HH value of LI of the receiver.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.Flash alarm is provided on HH value of LI of the HCL storage receiver.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Receiver may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is provided to closed charging line XV & transferring pump tobe stop at HH pressure of receiver.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Receiver Bottom valve left open/pass	Health hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve available at bottom of the receiver.	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6	1. Flange guard to be provided on all flanges.	2	4	8
			Receiver body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	Not applicable									
		Instrument Air failure	Air compressor failure	Receiver may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is to be air failed to closed condition.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Not applicable	No HSE hazard/Process Delay								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CaCl2 transfer in cacl2 KOD column(010CM-085) by cacl2 dosing tank (012RT-176) by gravity**										
1	Quantity/Flow	No/Less	Line leakage	Health hazard due to spillage	1. Line pressure test is performed before start-up. 2.Spill is provided in the nearby area.	3	3	9	1. Flange guard to be provided in all the flanges.			
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause	No HSE hazard								
		High	Human error(Manual vent line valve is not open of column)	column may pressurise	1.Vent is provided in column & ensure before startup that valve is open condition. 2.column design pressure is 6 bar. 3.Trained manpower will operate the operation. and ensure valve position before start operation.	3	4	12				
3	Temperature	Low	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in the column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in column with high and high high alarm. 5.Flash alarm is provided on HH value of RTD of the column.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	column Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in column.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket(teflon) is used.	3	3	9				
			column body leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of column is performed periodically.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture	Overflow from column and lead to spillage/health hazard	1. Jacket PM is performed before start-up. 2. Utility media is compatible with the reaction mass.	2	3	6				
5	Composition	Other than		No HSE hazard								
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not Applicable									
Stream-2		**Heating in CaCl2 KOD column(KOD-102) through thermo siphon reboiler(HE-105)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1	-	-				-			
		High/More	Refer high flow of Stream 1	-	-				-			

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
8	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	column may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in column & ensure before startup that valve is open condition. 5.PM of TCV is carried out as per predefined schedule.	3	4	12				
			Human error(Manual ventline valve is not open of column)		1.Trained manpower will operate the operation. and ensure valve position before start operation.	3	4	12				
9	Temperature	Low	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in column with high and high high alarm. 5.PM of TCV is carried out as per predefined schedule. 6.Flash alarm is provided on HH value of RTD of the column. 7.Upper limit of TCV set value is freeze as per process requirement.	3	4	12				
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the column with high and high high alarms. 2.Trained manpower is deputed for DCS operation. 3.Interlock is provided to closed the steam TCV at HH value of TI of column.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TI malfunctioning of column		1.TI is provided in utility supply & return line.	3	4	12				
10	Level	Low	Line/Flange leakage	Health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Compatible gasket is used prevent gasket leakage.	3	3	9				
			column bottom valve passed		1.Compatible MOC of valve is used at bottom of the column. 2.Double manual valve is provided at bottom of the column.	3	3	9				
			column Leakage		1.column MOC is compatible with material. 1.column thickness testing is performed on quarterly basis as per PM schedule.	3	3	9				
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	column may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position to be air fail to close.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.Steam TCV is closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Hot CaCl2 solution transfer in distillation column by gravity**										
13	Quantity/Flow	No/Less	Line leakage	Health hazard due to spillage	1. Line pressure test is performed before start-up.	3	3	9				
			Drain point valve open/passed	Health hazard due to spillage	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.Recommend to provide dual manual valve/blind at drain point/sample point.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause	No HSE hazard								
		High	Human error(Manual vent line valve is not open of distillation column)	column may pressurise	1.Vent is provided in column & ensure before startup that valve is open condition. 2.Trained manpower will operate the operation. and ensure valve position before start operation. 3.2 no of PT is available on column with high and high high alarm. 4.RD is also provided in distillation column. 5.PSV is also provided in distillation column. 6.Flash alarm is provided on HH value of PT of the distillation column.	3	4	12				
15	Temperatu re	Low	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in the column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in column with high and high high alarm. 5.Flash alarm is provided on HH value of RTD of the column.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12				
16	Level	Low	Refer low flow									
			Column body leakage	Health hazard due to spillage	1.PM of distillation column and pressure test is performed before startup and as per predefine schedule.	3	3	9				
		High	No probable cause									
17	Composition	Other than		No HSE hazard								
18	Others	Static Electricity	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not Applicable									
Stream-4		**Aqueous collection in aqueous storage tank HCL plant(010ST-223) from condenser**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Health hazard may possible due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.150 class flange is used. 4.Flange guard is provided on the flanges.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup. 2.LI is available in aqueous tank to monitor the level of the tank.	3	1	3				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Health hazard due to spillage	1.Trained manpower will deputed for operation and verified valve position before startup. 1.Double valve/blind is provided to prevent valve passing/leakage.	3	3	9				
			No/low level in CaCl2 KOD column	No HSE hazard/Process Delay	1.Manual LI is provided in the KOD column.	2	1	2				
			Utility failure in condenser	health hazard may possible	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE flash alarm tobe provide.	3	3	9				
			Top collection line CV stuck	No HSE hazard								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(vent line manual valve is not open)	Tank may pressurize	1.Trained man power is deputed for operation and ensure proper lineup before startup. 2.PT is available in aqueous tank with high and high high alarm. 3.Aqueous tank is design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the aqueous tank.	3	4	12				
			Heating stopped	No HSE hazard/Process Delay	1.Steam TCV indication is available on DCS.							
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Tank may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard. 4.Flash alarm is provided on high high value of LI of aqueous tank.	3	3	9				
			Human error(Steam TCV more percentage open in	Pressure rise may possible in column	1.Trained manpower is deputed for DCS operation. 2.Steam TCV percentage opening indication is available on DCS.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			thermosiphon reboiler)									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(vent line manual valve is not open)	Tank may pressurize	1.Trained man power is deputed for operation and ensure proper lineup before startup. 2.PT is available in aqueous tank with high and high high alarm. 3.Aqueous tank is design pressure is up to 6 bar. 4.Flash alarm is provided on HH value of PT of the aqueous tank.	3	4	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Tank leakage	Health hazard due to spillage	1. Aqueous tank design pressure is upto 6 bar. 2. Pressure test is performed before start-up. 3. LI is available in the with low and low low alarms.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Equipment thickness testing is carried out as per define schedule.							
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Heating , maintaining and CaCl2 circulation in distillation column(010CM-084)**										
1	Quantity/Flow	No/Less	CaCl2 Circulation pump trip/stops	No HSE hazard/Process Delay	1.Circulation pump running indication is available on DCS.	3	1	3				
			Human error (Discharge manual valve not opened).	Transferring line may pressurise	1. Trained manpower will deputed for operation. 2.Line design pressure is sustained to resist maximum discharge pressure of pump.	4	3	12				
			Line leakage	Health hazard due to spillage	1.Line pressure test is performed before startup. 2.Compatible gasket is used. 3. Flange guard is provided on all flanges.	3	3	9				
			Line chocked	Line may pressurise	Material having no choking property.	3	3	9				
		High/More	No probable cause	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Pressure rise may possible in the column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm. 5.Manual valve is available in line of steam TCV.	3	4	12				
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in primary condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary and secondary to tertiary condenser line.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					6.TI is provided in final vent line connected with knockout drum. 7.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE respectively steam TCV and HCl feeding line FCV to be closed. 8.Interlock is provided to closed steam TCV at HH pressure of the distillation column.							
3	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PM of TCV is performed before start operation. 5.Five numbers of TI is provided in distillation column with high and high high alarm.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.Five numbers of TI is provided in distillation column with high and high high alarm. 3. Flash alarm is provided at HH temperature of bottom and top of the column.. 4. Interlock is provided to close steam line TCV at HH temperature of top and bottom of the column. 5. Interlock is provided to close steam line TCV at HH temperature of the final vent/vapour line of TI. 6.Flash alarm is provide on HH temperature of final vent/vapour line of reactor.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule. 3.Five number of TI is provided in distillation column.	3	4	8				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
4	Level	Low	Column body leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage	1.Pressure testis performed before startup. 2.PM of distillation column is performed as per predefine schedule. 3.Manual LI is available in distillation column to monitor the level of distillation column. 4.LI is available in distillation column with indication on DCS.	3	3	9				
		High	Condenser leakage	Column may overflow	1.Before start process hydro test of condenser is performed. 2.LI is available in column with high and high high alarm.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Temperature rise may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of steam TCV is air failed to closed condition.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-2		Continuous feeding from HCl receiver(011TK-318) to distillation column(010CM-084) through feeding pump (010TP-321)										
7	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.							
			Line/Flange leakage	Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.150 class flange is used.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3.Inbuilt PSV is available in the pump.	3	3	9				
			Sample point/Drain point manual valve pass	Health hazard due to spillage	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.Double valve/blind provision to prevent valve passing/leakage.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			No/low level in receiver	No HSE hazard/Process Delay	1.LI is available in receiver to monitor the level of the receiver.							
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	1.Flooding may possible in column/Process Delay 2.Pressure rise may possible in column	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					high high value of LI of column.							
			Human error (Wrong input set in HCL feeding line FCV)		1.Trained manpower is deputed for DCS operation. 2.Two number of PT is available in column with high and high high alarm. 3.Rupture disc with catch pot is also provided in distillation column. 4.Safety valve is also provided in distillation column. 5.Upper limit of set point of HCL feeding line flow meter is freeze. 6.Flash alarm is provided on HH value of both PT of the distillation column.	3	4	12				
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	HCl feeding line FCV failure/stuck open	1.Flooding may possible in column/Process Delay	1.PM is performed of FCV before start up. 2.Bypass loop is available in case of FCV failure & bypass	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
				2.Pressure rise may possible in column	procedure will be followed. 3.FCV indication is available on DCS with percentage. 4 Two numbers of PT is available in column with high and high high alarm. 5.Manual valve is available in line of HCl feeding line FCV.							
			Human error (Feeding pump run with full capacity)		1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Wrong input set in HCL feeding line FCV)		1.Trained manpower is deputed for DCS operation. 2.Two number of PT is available in column with high and high high alarm. 3.Rupture disc with catch pot is also provided in distillation column. 4.Safety valve is also provided in distillation column. 5.Upper limit of set point of hcl feeding line flow meter is freez. 6.Flash alarm is provided on HH value of both PT of the distillation column.	3	4	12				
			PCV stuck of final dry HCL gas line/ pressure control valve of column		1.PM is performed of PCV before start up. 2.Bypass loop is available in case of PCV failure & bypass procedure will be followed. 3.PCV indication is available on DCS with percentage. 4 Two numbers of PT is available in column with high and high high alarm. 5.Manual valve is available in line of final PCV. 6.PT is available in line of final	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					PCV with high and high high alarm.							
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in primary condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary and secondary to tertiary condenser line. 6.TI is provided in final vent line connected with knockout drum. 7.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE HCl feeding line FCV to be closed. 8.Interlock is provided to	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					closed HCl feeding line FCV at HH pressure of the distillation column.							
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	Refer low Flow									
		High	Refer high Flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Column may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of HCL feeding FCV is to be air failed to closed condition.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 5		Node Description : Scrubber System(010TK-347)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream -1		Reaction in scrubber tank (010TK-347)										
1	Quantity/Flow	No/Less	Circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS . 2.Vent line of scrubber column is dipped into vent pot. so, less chances of gas exposure. 3.Flash alarm is provided on trip/stop of scrubber circulation pump. 4.Interlock is provided to stop HCl feeding pump and closed feeding line FCV incase of circulation pump stop/trip. 5.Interlock is provided to closed the steam TCV of both thrermosyphon reboiler of KOD column and distillation column respectively.	3	3	9				
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.Spill kit is provided in nearby area to contain spillage.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1 Date:- 18/04/2017			
Node 5		Node Description : Scrubber System(010TK-347)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4.Flange guard is provided on the flanges.							
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Pump discharge valve should be critical locked open condition and tag to be provide on that.	2	3	8
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	1.Trained manpower is deputed for operation and ensure proper line up before start up. 2.Double valve is provided to prevent valve passing/leakage.	3	3	9				
			NRV chocked in pump discharge line	Transferring line may pressurise and can lead to spillage/health hazard	Compatible MOC of NRV is used so chocking not possible.	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Jacket puncture in graphite absorber	Scrubber tank may overflow	1.Pressure test is performed of absrober before startup. 2.LI is available in scrubber tank with high and high high alarm. 3.Flash alarm is provided on HH value of LI of scrubber tank.	2	3	6				
			Jacket puncture of the scrubber tank		1.Pressure test is performed of scrubber tank . 2.LI is available in scrubber tank with high and high high alarm. 3.Spark test of scrubber tank is performed before startup.	2	3	6				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV is available in the pump discharge line to prevent reverse flow.	3	2	6				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low vacuum	Venturi chocked of circulation line	vacuum drop in scrubber tank	1.Material having no choking property. 2.Before start up it is verify that venturi is clean.	3	2	6	-			

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1 Date:- 18/04/2017			
Node 5		Node Description : Scrubber System(010TK-347)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Vent line valve of final scrubber tank is not open)	Scrubber tank may pressurise	1.PT is available on the final tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar. 4.PT is available in scrubber tank with high and high high alarm. 5. Flash alarm is provided on HH alarm value of PT of final scrubber tank. 6.Flash alarm is provided on HH alarm value of PT of scrubber tank. 7.Interlock is provided to stop the feeding pump of HCl and FCV of feeding line at HH pressure of scrubber tank and final vent pot.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Human error(Vent line valve of intermediate scrubber tank is not open)	Intermediate scrubber tank may pressurise	1.PT is available on the intermediate scrubber tank with high and high high alarms. 2. Trained manpower will perform the operation and ensure valve is open before startup.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1 Date:- 18/04/2017			
Node 5		Node Description : Scrubber System(010TK-347)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3. Scrubber tank design pressure is up-to 6bar. 4.Flash alarm is provided on HH value of PT of intermediate scrubber tank. 5.Interlock is provided to stop the feeding pump of HCl and FCV of feeding line at HH pressure of intermediate scrubber tank.							
3	Temperature	Low	No credible cause	-	TI is available in receiver with low and low low alarms							
		High	Utility failure in jacket of the tank Utility failure in jacket of the absorber	Temperature rise may possible in scrubber tank	1.TI is available in scrubber tank with high and high high alarms. 2.TI is available in utility supply and return line of scrubber tank with alarms. 3.TI is available in utility supply and return line of graphite absorber. 4.Utility circulation pump indication is provided on DCS. 5.Flash alarm is provided on HH value of TI of the scrubber tank.	3	4	12				
4	Level	Low	Refer low Flow									

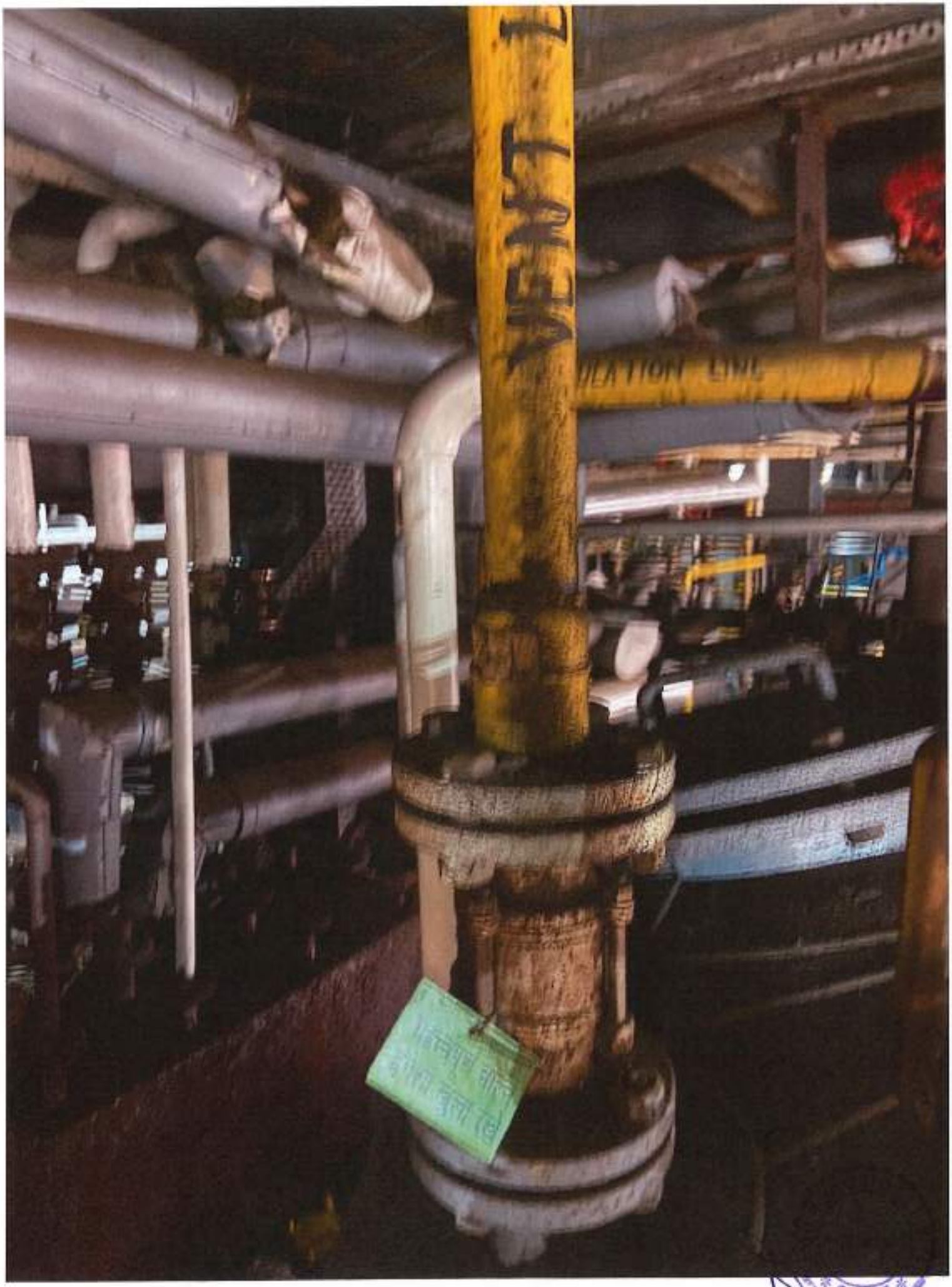
HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1 Date:- 18/04/2017**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Low level in tank	Tank body leakage	Gas/Liquid Exposure due to spillage	1.Receiver MOC is compatible so leakage is not possible 2.LI is provided in scrubber tank with low and low low alarm.	2	3	6				
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity		No HSE hazard								
		Instrument Air failure	Air compressor failure	Pressure rise may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of vacuum PCV is to be air failed to closed condition.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decouple due to mechanical failure	No HSE hazard	Agitator running indication is available on DCS.	3	1	3				

---- END OF THE REPORT -----

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DRY HCl HAZOP Recommendation Summary						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	CaCl2 Dosing reactor(012RT-176)	Water charging in CaCl2 Dosing reactor(012RT-176)	Vent line valve should be locked open with tagging.	Mechanical	Completed	1
2	CaCl2 KOD column-102(010CM-085)	CaCl2 transfer in cacl2 KOD column(010CM-085) by cacl2 dosing tank (012RT-176) by gravity	Flange guard to be provided in all the flanges.	Mechanical	Completed	2
3			TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	3
4	Distillation Column(010CM-084)	Heating , maintaining and CaCl2 circulation in distillation column(010CM-084)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	4
5	Scrubber System(010TK-347)	Reaction in scrubber tank (010TK-347)	Pump discharge valve should be critical locked open condition and tag to be provide on that.	Mechanical	Completed	5

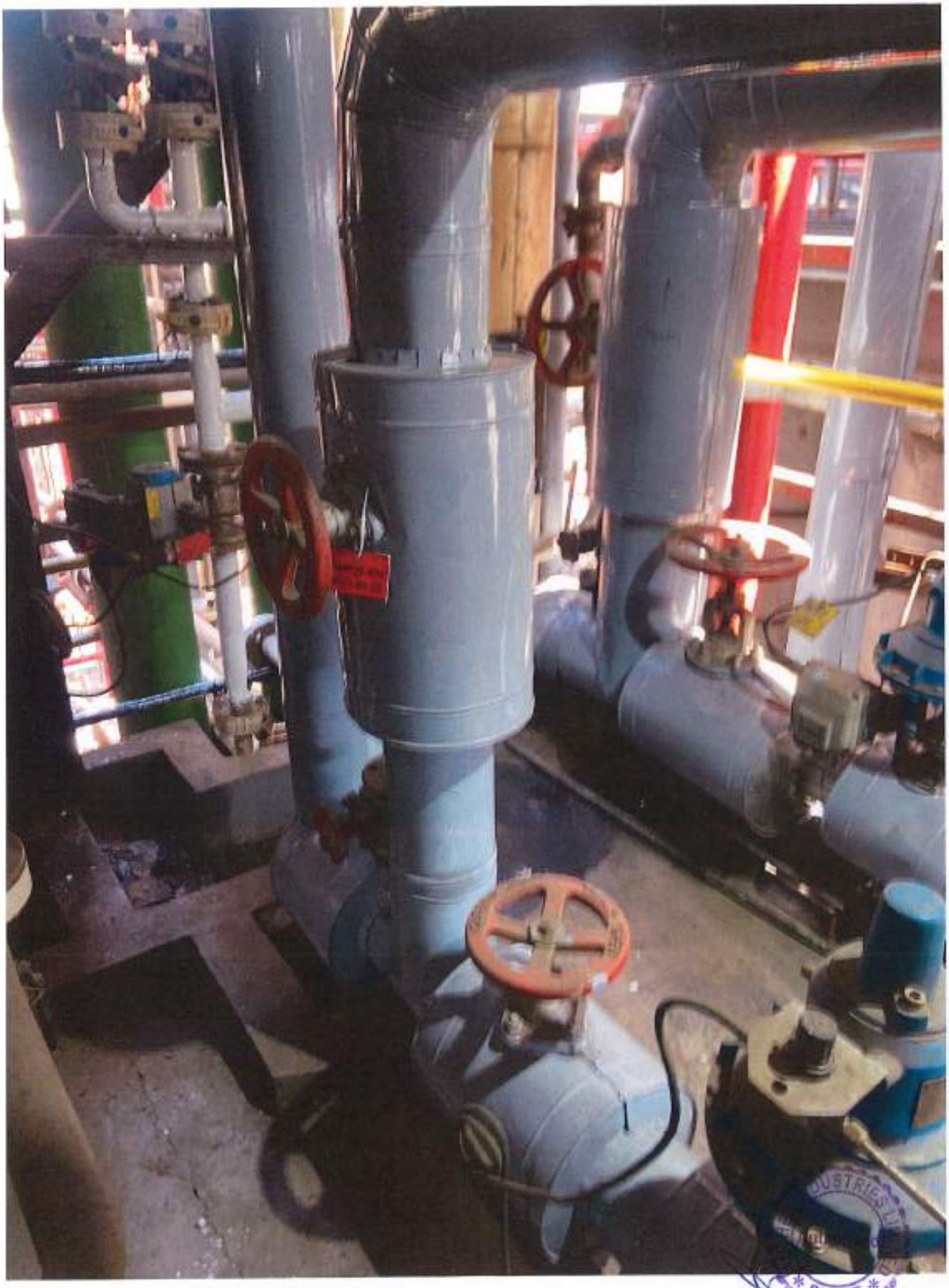




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SURAT

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ATHER INDUSTRIES LIMITED
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HAZOP STUDY REPORT OF

MMBC PLANT

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

JANUARY 2020

aether
elementally innovative



NEXA
Process Safety Engineers

1455

AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

HAZOP STUDY REPORT OF

MMBC PLANT

JANUARY 2020

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat





Proprietor

08-01-2020

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for MMBC Plant.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for MMBC Project.
It has 13 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	MCT storage tank(040ST-145)
2.	THF storage tank(040ST-179)
3.	Grignard addition reaction reactor(043RT-083)
4.	Grignard reactor(042RT-086)
5.	Coupling reactor(042RT-089)
6.	Quenching reactor(041RT-095)
7.	Chlorination reactor(042RT-103)
8.	Chlorination reactor(042RT-104)
9.	Solvent recovery reactor(041RT-106)
10.	Crude MMBC storage reactor(042RT-105)
11.	Final distillation reactor(041RT-107)
12.	Pure MMBC storage tank(041ST-160)
13.	HCl receiver for scrubber(040TK-252)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other’s ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.

5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be

subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

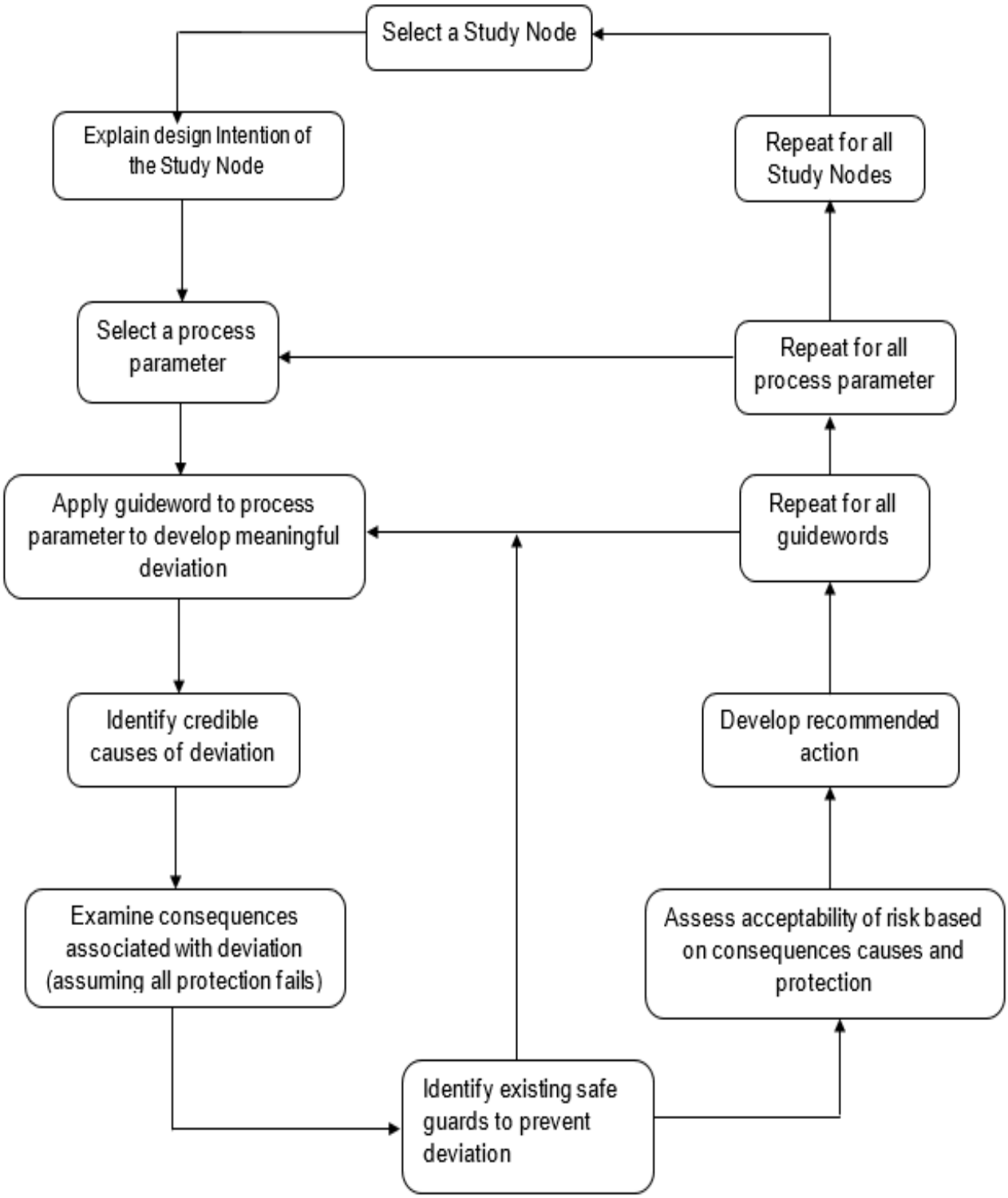
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	8203/MMBC-STAGE-2/001 8203/MMBC-STAGE-3/001 8203/MMBC-STAGE-4/001 8203/MMBC-Scrubber system/001

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for

his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP

- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

MMBC HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	MCT storage tank(040ST-145)	Material loading and unloading in MCT storage tank	Recommend to provide overload tripping on pump.	Electrical
2	Grignard addition reaction reactor(043RT-	MCT charging in grignard addition reactor (043RT-083)	Spill kit to be provided in nearby area to contain	Safety

MMBC HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
	083)		spillage.	
3	Quenching reactor(041RT-095)	10% H2SO4 charging in quenching reactor (041RT-095)	Vent line valve should be locked open.	Mechanical
4	Chlorination reactor(042RT-104)	Thionylchloride addition from Thionylchloride day tank(043TK-246) in chlorination reactor(042RT-104)	Flange guard to be provided on all flanges.	Mechanical
5	Solven recovery reactor (041RT-106)	Solvent recovery from solvent recovery reactor(041RT-106)	TCV bypass valve should be locked closed condition with tagging.	Mechanical
6	Pure MMBC storage tank(041ST-160)	Material loading and unloading in MMBC storage tank(041ST-160)	Double manual valve type be provide in N2 line.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		Title : HAZOP Study Of MMBC							Plant Name: Plant MMBC Date:- 04-12-2019			
Node 1		Node Description : MCT storage tank(040ST-145)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Material loading and unloading in MCT storage tank										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.Flow meter is available in material transferring line . 3.LI is available in storage tank to monitor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 1		**Node Description : MCT storage tank(040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 1		**Node Description : MCT storage tank(040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					2.All electrical installation are flameproof as per HAC classification.							
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tank farm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 1		**Node Description : MCT storage tank(040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.PVRV is available in tank.							
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			PVRV chocked/malf unctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 1		**Node Description : MCT storage tank(040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is avaiable on tank.	3	4	12				
			PVRV chocked/malf unctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12				
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 1		**Node Description : MCT storage tank(040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Tank bottom valve passed/leakage									
		High	Refer high Flow									
5	Composition	Other than	Wrong material supplied from vendor	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before tanker unloading start.	2	3	6				
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 1		**Node Description : MCT storage tank(040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					the same periodically.							
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 2		**Node Description : THF storage tank(040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in THF storage tank**										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.Flow meter is available in material transferring line . 3.LI is available in storage tank to monitor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in nearby area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 2		**Node Description : THF storage tank(040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 2		**Node Description : THF storage tank(040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tank farm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-							
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 2		**Node Description : THF storage tank(040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			PVRV chocked/malfu nctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is avaiable on tank.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 2		**Node Description : THF storage tank(040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12				
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC	3	3	9				
			Tank bottom valve passed/leakage									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC Date:- 04-12-2019**			
Node 2		**Node Description : THF storage tank(040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					classification.							
		High	Refer high Flow									
5	Composition	Other than	Wrong material supplied from vendor	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before tanker unloading start.	2	3	6				
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**MCT charging in grignard addition reactor (043RT-083)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	2	6				
			MCT Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage.	2	3	6
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is upto 6bar.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Reactor Bottom valve left open/pass	Health&fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earhing jumper is provided in flange joint.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream-2		**THF charging in grignard addition reactor (043RT-083)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	2	6				
			THF Transfering pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12				
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Reverse	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is upto 6bar.	3	4	12				
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left open/pass	Health&fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earhing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream-3		**Mixing in grignard addition reactor (043RT-083)**										
1	Quantity/Flow	No/Less	Refer low flow of stream 1&2	-	-				-			
		High/More	Refer high flow of Stream 1&2	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	No probable cause	-	-				-			
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurise	1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					is 3 kg/cm2.							
			Human error(Manual vent line valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	3	4	12				
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	3	4	12				
3	Temperature	Low	Human error(cooling water supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				
		High	Human error(Steam supply line valve open)	Temperature rise may possible in reactor	1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used. 5. LI is available in the reactor.	3	3	9				
			Reactor bottom valve passed/leakage		1.Compatible MOC of valve is used at bottom of the reactor.	3	3	9				
			Reactor Leakage		Reactor MOC is compatible with material.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.MOC is compatible with material. 2.PG is available in utility return line. 3.No incompatible hazard with reaction mass& utility in case of jacket puncture.	3	3	9				
5	Composition	Other than	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	No probable cause	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earhing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	No load tripping is provided on agitator.	3	2	6				
Stream-4		**MMBC grignard catch pot (043TK-244)**										
1	Quantity/Flow	No/Less	No probable cause	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	2	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	High pressure in grignard reactor & grignard adddition reactor	catch pot may overflow	1.PT is available in grignard addition & grignard reactor with high and high high alarm. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
			RD burst of grignard reactor									
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Catch pot may pressurise	1.PT is available in catch pot with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.catch pot design pressure is upto 6bar.	3	4	12				
			Vent line flame arrestor chocked		PM of flame arrestor is performed before startup.	3	4	12				
3	Temperatu	Low	No probable	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 04-12-2019**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	re		cause									
		High	No probable cause	No HSE hazard								
4	Level	Low	No probable cause	No HSE hazard								
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earhing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Mg turnings charging into grignard reactor(042RT-086)**										
1	Quantity/Flow	No/Less	Human Error(Less Quantity charged)	No HSE hazard								
		High/More	Human Error(More Quantity charged)	No HSE hazard								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	Not Applicable									
		High	Not Applicable									
3	Temperature	Low	Not Applicable									
		High	Not Applicable									
4	Level	Low	Not Applicable									
		High	Not Applicable									
5	Composition	Other than	Not Applicable									
6	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the hopper. 2. Earthing strip is provided on the flanges.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.N2 inertisation to be perform during charging.							
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
		Leakage spillage	-	No HSE hazard								
Stream-2		**(THF+MCT) addition in grignard reactor(042RT-086) from grignard addition reactor(043RT-083)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of reactor not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in addition line	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3.Fire extinguisher and fire hydrant point is provided in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may implode	1. SOP is available to open vent valve before starting transferring activity. 2. compound PT is available in the grignard addtion reactor with low and low low alarms.	3	4	12				
			Low level in grignard addition reactor	No HSE hazard	Flow meter is available in addition line .	3	1	3				
			Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation. 2.Material having no chocking property.	3	2	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line/vapour line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3.RD is available on	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					reactor for overpressure protection.							
			Human error (Vent line of catch pot not open)		1.PT is available in catch pot with high and high high alarm. 2.RD is available on reactor for overpressure protection.							
			Flame arrestor chocked		PM of flame arrestor is performed before startup.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition.	3	4	12				
			THF + MCT addition rate fast		Refer high flow safeguard	3	4	12				
3	Temperature	Low	Cooling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high alarm.							
			Human error (Wrong temperature set point is given in TIC(temperature indicator & controller)		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12				
			Human error (TCV bypass line passed/open)		No existing safeguard	3	4	12				
			Fast addition rate of THF+MCT		Flowmeter & totaliser is available in the addition line.	3	4	12				
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				
4	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9				
			Reactor body leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 04-12-2019**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the hopper. 2. Earthing strip is provided on the flanges. 3.N2 inertisation to be perform during charging.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		Title : HAZOP Study Of MMBC							Plant Name: Plant MMBC , Date:- 04-12-2019			
Node 4		Node Description : Grignard reactor(042RT-086)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		Title : HAZOP Study Of MMBC							Plant Name: Plant MMBC , Date:- 05-12-2019			
Node 5		Node Description : Coupling reactor(042RT-089)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		THF charging in Coupling reactor(042RT-089)										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3. Line pressure testing is done before start up.	3	2	6				
			THF Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12				
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2. Fire extinguisher and fire hydrant point is available in near by area. 3. All electrical installation are flameproof as per	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					HAC classification.							
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is upto 6bar.	3	4	12				
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Reactor Bottom valve left open/pass	Health & fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2. Earthing jumper is provided in flange joint.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream -2		**AECAT-703 charging through hopper in coupling reactor(042RT-089)**										
1	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard/Process Delay	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3	-			
		High/More	Human Error (More quantity charged)	No HSE hazard	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	No probable cause									
		High	No probable cause									
5	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	4	12				
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	-	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	-	Two numbers of DG is available for power backup.	3	1	3	-			
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3	-			
		Agitation	-	No HSE hazard								
Stream-3		**CO2 addition in coupling reactor(042RT-089)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of CO2 PRS not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	2	6				
			Human error (manual valve of CO2 receiving line on CO2 coupling reactor not opened).									
			Line leakage	leakage may lead to gas exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3. Flange guard is provided on all flanges. 4.Compatible gasket isused. 5.All electrical installation	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					as per HAC lassification.							
			Low pressure in CO2 cryo system	No HSE hazard/Process Delay	1.Flow meter is available in addition line. 2.PT is available in CO2 addition line .	3	2	6				
			Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CO2 addition line ROV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Brine supply provision is available in jacket of the reactor to control temperature.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5. Interlock is provided to closed addition ROV at HH temperature of reactor.							
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse										
		Mis-directed flow										
2	Pressure	Low	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	CO2 supply pressure high	Reactor may pressurize	1. CO2 PRS system available to supply required pressure. 2. PCV available to supply CO2 pressure in coupling reactor. 3. ROV is available in the CO2 supply line. 4. PT is available in reactor with high and high high alarm. 5. Interlock is available to close ROV and PCV in case of high high pressure of reactor. 6. PT is available in the CO2 supply line with high and high high alarms. 7. Interlock is also available to close ROV and PCV of CO2 supply line on high high value of CO2 supply line PT.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No probable cause	No HSE hazard.		0	0	0				
		High	CO2 supply pressure high	Exotherm may possible in reactor	1. TI is available in the reactor with high and high high alarms. 2. Interlock is available to close ROV & PCV of CO2 supply line on high high value of TI of the reactor. 3. ROV & PCV is available in the CO2 supply line. 4. For high supply pressure safeguards, refer high pressure scenario. 5. Interlock is available to open the brine suply line ROV of jacket of the reactor at HH value of TI of the reactor. 6.Interlock is available to open the brine return line ROV of tube bundle at HI value of TI of reactor.	3	4	12				
			Human error(Manual valve of steam supply	Exotherm may possible in reactor	1.Trained manpower is deputed for operation and ensure proper line up	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			line left open/passed)		before startup.							
4	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	3	3	9				
			Reactor body leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer low Flow	Reactor may overflow and chances of spillage/leakage		0	0	0				
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	3	9				
			Tube bundle leakage in reactor		PM of tube bundle is performed before startup.	3	3	9				
5	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the hopper. 2. Earthing strip is provided on the flanges. 3. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					available.							
		Power failure	GEB power failure	Runaway may possible	DG backup is provided to all critical equipments.	3	3	9				
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Decoupling	Runaway may possible	No load tripping available in case agitator decoupling.	4	3	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**10% H2SO4 charging in quenching reactor (041RT-095)**										
1	Quantity/Flow	No/Less	Human error(10%H2SO4 receiving line valve not open)	Process delay No HSE hazard	1.Trained manpower is deputed for operation and ensure proper line up before startup. 2.Flow meter is available in addition line.	3	1	3				
			Human error (Discharge manual valve not opened).									
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket is used. 3.Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available on reactor with high and high high alarm.	3	4	12	1. Vent line valve should be locked open.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Low level in 15%H2SO4 tank	No HSE hazard	1.Flow meter is available in transferring line. 2.LI is available in H2SO4 storage tank with low and low low alarm.	3	2	6				
			Flow meter malfunction	Process delay	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	1. Exotherm may possible in the reactor and fumes may space through vent line of reactor. 2. Overflow from reactor may lead to spillage hazard	1. TI is available in the reactor with high and high high alarms. 2. Chilling & cooling utility supply provision is available to control temperature. 3.Flow meter with CV is available in H2SO4 addition line. 4.PT is available in reactor with high and high alarm.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		Title : HAZOP Study Of MMBC							Plant Name: Plant MMBC , Date:- 05-12-2019			
Node 6		Node Description : Quenching reactor(041RT-095)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor. 3.PT is available in reactor with high and high alarm. 4. Reactor design pressure is up to 6 kg/cm2.	3	4	12				
3	Temperature	Low	No probable cause									
		High	Human Error (Manual valve of utility supply & return not opened)	Exotherm may possible in the reactor	1. Trained manpower and SOP is available to line up chilling water before solvent charging. 2. TI is available in the reactor and utility return & supply line with high and high high alarms. 3.TI is available in reactor with high and high high alarms.	3	4	12				
			TI malfunction		TI is available in the utility supply & return line with high and high high alarms.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Fast addition of H2SO4 in reactor		Flowmeter & totaliser is available in the addition line.	3	4	12				
			Human error(Manual valve of steam supply line open/passed)		1.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12				
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	4	8				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	4	8				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	4	8				
		High	Refer High/More flow									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
			DG failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	Exotherm may possible	1.No load tripping is available.	3	4	12				
Stream-2		**Toluene charging in quenching reactor (041RT-095)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise can lead to fire/health hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up. 4.Fire extinguisher and fire hydrant point is available in near by area. 5.All electrical installation are flameproof as per HAC classification	3	3	9				
			Toluene Transfering pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	2	6				
			Line leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			No level in toluene storage tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available in tank with low and low low alarm.	3	1	3				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor ddesign pressure is upto 6 kg/cm2.	3	4	12				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Flow meter with totaliser is available in toluene charging line. 2.Traineed manpower is deputed for DCS operation.	3	2	6				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-	No probable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		directed flow	cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	3	4	12				
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard & fire hazard due to spillage	1. Trained manpower and SOP is available before line up. 2. Double manual valve is available at bottom of the reactor.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is available in near by area. 6.All electrical installation are flameproof as per HAC classification.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earhing jumper is provided in flange joint.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream-3		**Organic material loading from quenching reactor to organic storage tank(040ST-158) & unloading of organic storage tank(040ST-158)**										
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.All electrical installation are flameproof as per HAC classification.							
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9				
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High/More	LS malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	Wrong line up(Manual valve or pump start of aqueous tank instead of organic tank line up)	No HSE hazard/Process Delay	-							
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
			Flame arrestor chocked (Storage tank	Tank may implode	PM of flame arrestor is performed before startup.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			vent line)									
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	PM of flame arrestor is performed before startup.	3	4	12				
3	Temperatu re	Low	No credible cause									
		High	No credible cause									
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Tank bottom valve passed/leakage									
		High	Refer high Flow									
5	Compositio	Other										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	n	than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Aqueous material loading from quenching reactor to aqueous storage tank(040ST-156) & unloading of aqueous storage tank(040ST-156)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					HAC classification.							
			Human Error (Discharge Valve not opened)	No HSE hazard	1.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9				
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
		High/More	LS malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	Wrong line up(Manual valve or pump start of organic tank instead of aqueous tank	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			line up)									
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
3	Temperatu re	Low	No credible cause									
		High	No credible cause									
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Tank bottom valve passed/leakage									
		High	Refer high Flow									
5	Compositio	Other										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	n	than										
6	Others	Static Electricity	-									
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**THF recovery from chloination reactor(042RT-103)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line/vapour line valve not opened)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in reactor with high and high high alarm. 3.Reactor design pressure is upto 6 bar.	3	4	12				
			Vent line flame arrestor chocked		PM is performed before start-up and record is maintained.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					provided in N2 supply line							
3	Temperature	Low	Human error(cooling water supply line valve open/passes)	No HSE hazard	1.Trained manpower is deputed for operation and ensure valve is open before startup.							
		High	TCV failure/stuck open	Reactor may pressurise & Exotherm may possible	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PM of TCV is performed before start operation. 5.TI is provided inn reactor with high and high high alarm.	3	4	12				
			Human error (TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.TI is available in final vent line with high and high high alarm. 3.TI is provided inn	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					reactor with high and high high alarm.							
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up. 4.Tantalum plug is provided inn the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping is provided.	3	3	9				
Stream -2		**Dimethyl formate charging through hopper in chloination reactor(042RT-103)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
1	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard/Process Delay	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		High/More	Human Error (More quantity charged)	No HSE hazard	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	No probable cause									
		High	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Compositio n	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	4	12				
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	-	Two numbers of DG is available for power backup.	3	1	3	-			
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3	-			
		Agitation	-	No HSE hazard								
Stream-3		**Thionylchloride addition from Thionylchloride day tank(043TK-246) in chlorination reactor(042RT-103)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of day tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line . 3.Loadcell is available in thionyl chloride day tank.	3	3	9				
			Human error (manual valve of Thionylchloride receiving line of chlorination reactor not opened).									
			Line leakage	Spillage may lead to gas/liquid exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage.	3	3	9				
			Human error (Vent line valve not opened)	Day tank of may implode	1. SOP is available to open vent valve before starting transferring activity. 2.Day tank is design for full vacuum.	3	4	12				
			Low level in (043TK-246) thionyl chloride day tank	No HSE hazard	1.Flow meter is available in addition line 2.Loadcell is available in dday tank .	3	1	3				
			Flow meter malfunctioning/chocked	Process delay	.Flow meter PM to be performed before start the operation.	3	2	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed addition line CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Scrubber line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			Title : HAZOP Study Of MMBC						Plant Name: Plant MMBC , Date:- 05-12-2019			
Node 7		Node Description : Chlorination reactor(042RT-103)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					reactor. 4.Trained manpower is deputed for operation.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor.	3	4	12				
			Thionylchloride addition rate fast		Refer high flow safeguard	3	4	12				
			Scrubber circulation pump trip/stop		Pump running indication is available on DCS	3	4	12				
			Venturi chocked		Material having no chocking property.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	Cooling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			Fast addition rate		Flowmeter & totaliser is available in the addition line.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				
4	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9				
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**THF recovery from Chlorination reactor(042RT-104)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line/vapour line valve not opened)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in reactor with high and high high alarm. 3.Reactor design pressure is up to 6 bar.	3	4	12				
			vent line flame arrestor chocked		PM is performed before start-up and record is maintained.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					provided in N2 supply line							
3	Temperature	Low	Human error(cooling water supply line valve open/passes)	No HSE hazard	1.Trained manpower is deputed for operation and ensure valve is open before startup.							
		High	TCV failure/stuck open	Reactor may pressurise & Exotherm may possible	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PM of TCV is performed before start operation. 5.TI is provided inn reactor with high and high high alarm.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.TI is available in final vent line with high and	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high high alarm. 3.TI is provided inn reactor with high and high high alarm.							
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design Pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				hazard may possible	used in jacket of the reactor.							
			Condenser leakage		1.PM is performed before startup.	3	3	9				
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up. 4.Tantalum plug is provided inn the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping is provided.	3	3	9				
Stream -2		**Dimethyl formate charging through hopper in chloination reactor(042RT-104)**										
1	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard/Process Delay	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3	-			
		High/More	Human Error (More quantity charged)	No HSE hazard	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
5	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	4	12				
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	-	Two numbers of DG is available for power backup.	3	1	3	-			
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same	3	1	3	-			

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					periodically.							
		Agitation	-	No HSE hazard								
Stream-3		**Thionylchloride addition from thionylchloride day tank(043TK-246) in chlorination reactor(042RT-104)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of day tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line . 3.Loadcell is available in thionyl chloride day tank.	3	3	9				
			Human error (manual valve of thionylchloride receiving line of chlorination reactor not opened).									
			Line leakage	Spillage may lead to gas/liquid exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage.	3	3	9	1. Flange guard to be provided on all flanges.	2	3	6
			Human error (Vent line valve not opened)	Day tank of may implode	1. SOP is available to open vent valve before starting transferring activity. 2.Day tank is design for full vacuum.	3	4	12				
			Low level in (043TK-246)	No HSE hazard	1.Flow meter is available in addition line	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			thionyl chloride day tank		2.Loadcell is available in dday tank .							
			Flow meter malfunctioning/c hocked	Process delay	.Flow meter PM to be performed before start the operation.	3	2	6				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed addition line CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	3	4	12				
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error (Scrubber line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the reactor. 4.Trained manpower is deputed for operation.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor.	3	4	12				
			Thionylchloride addition rate fast		Refer high flow safeguard	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Scrubbber circulation pump trip/stop		Pump running indication is available on DCS	3	4	12				
			Venturi chocked		Material having no chocking property.	3	4	12				
3	Temperature	Low	Cooling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				
			Human error(TCV		No existing safeguard	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			bypass line passed/open)									
			Fast addition rate		Flowmeter & totaliser is available in the addition line.	3	4	12				
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				
4	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9				
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Solvent recovery from solvent recovery reactor (041RT-106)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12				
		High	No probable	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Vacuum	cause									
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					operation.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up. 3.Tantalum plug is provided in the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					periodically.							
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided.	3	4	12				
Stream-7		**Top Collection in receiver-500 LTR(043TK-250A) &(043TK-250B)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9				
			Human Error (Manual valve of material collection line on	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			receiver is not open)									
			Sample point/Drain point manual valve pass	Fire hazard due to spillage	1.All electrical installation are flameproof as per HAC classification. 2.Fire extinguisher and fire hydrant point is available near by area.	3	3	9				
			No/low level in solvent recovery reactor	No HSE hazard/Process Delay	No existing safeguard.	3	1	3				
			Loadcell malfunctioning	Overflow may possible from top collection receiver	1.Loadcell calibration is performed before startup. 2.No open vent in collection receiver.so, no chances of overflow.	3	2	6				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Receiver vent is given in vacuum pot .so,no chances of overflow. 4.Material is compatible	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					with utility.							
			Human error(Steam TCV more percentage open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.TI is available in distillation reactor with alarms.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	Human error(Manual valve of reflux line is fully open instead of collection line)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.							
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	No HSE hazard/Process Delay								
		High	No probable cause	No HSE hazard/Process Delay								
3	Temperatu re	Low	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Utility failure in condenser	Temperature rise may possible in receiver	1.TI is available in receiver with high and high high alarms. 2.TI is available in utility supply and return line of condenser.	3	3	9				
4	Level	Low	Receiver leakage	Fire hazard and health hazard due to spillage	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Loadcell is available in the collection receiver with low and low low alarms. 4.Thickness testing to be carried out as per PM schedule. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Human error (Withdrawal not done at regular interval)	Overflow may possible and lead to health hazard & fire hazard	1.Loadcell is available on receiver with high and high high alarms. 2.Receiver vent line is connected with vacuum pot. so, overflow is not possible.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**Crude MMBC transfer to crude MMBC storage reactor(042RT-105)**										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/process delay	No existing safeguard.	3	1	3				
			Human error (Discharge manual valve not opened).	Transferring line may pressurise	1. Trained manpower will deputed for drum charging. 2.line design pressure is sustained to resist maximum discharge pressure of pump. 3. Fire extinguishers are available in nearby places.	3	3	9				
			Line/Flange leakage	Fire hazard/Spillage	1.Line leakage testing is done before start-up . 2.Compatible gasket is used. 3.All electrical installation are flameproof as per HAC classification. 4. Fire extinguishers are available in nearby places.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(vent is not open in storage reactor)	Tank may pressurise	1.PT is available in the tank with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Tank design pressure is upto 6 bar.	3	4	12				
			Vent line flame arrestor chocked	Tank may pressurise	1.PM of flame arrestor is performed before startup. 2.Tank design pressure is upto 6 bar.	3	4	12				
			Line chocked	Line may pressurise	1.Line design pressure is sustained to resist maximum discharge pressure of pump. 2.Material having no chocking property.	3	3	9				
		High/More	No probable cause									
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error (reactor vent line valve not opened)	Reactor may pressurise	1.PT is available in the reactor with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Tank design pressure is upto 6 bar.	3	4	12				
			Vent line flame arrestor chocked		1.Material having no chocking property. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.Flame arrestor PM to be performed before start up.	3	4	12				
			N2 manual valve passed/left open		1.Vent is provided on reactor and verified by supervisor that valve is always open during process. 2.PT is available in reactor with high and high high alarms. 3.Reactor design pressure is up to 6 bar.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No credible cause	-	TI is available in tank with low and low low alarms							
		High	No credible cause	-	TI is available in tank with high and high high alarms.							
4	Level	Low	Tank body leakage	Fire hazard/Spillage	1.Material is compatible with reactor MOC 2.Pressure testing is performed before startup. 3.Fire extinguishers are available in nearby places.	3	3	9				
			Tank bottom valve leakage/passed		Double manual valve to be provide at bottom of the day tank.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No credible cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 05-12-2019**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Earthing continuity is verified before startup. 2. Dual earthing is provided in the reactor. 3. Earthing strip is provided on the flanges.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Product distillation from final distillation reactor(041RT-107)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12				
		High	No probable	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Vacuum	cause									
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					operation.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC**							**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up. 3.Tantalum plug is provided in the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12				
Stream-2		**Top Collection in receiver-500 LTR(043TK-251A) &(043TK-251B)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard due to spillage	1.All electrical installation are flameproof as per HAC classification. 2.Fire extinguisher and fire hydrant point is	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					available near by area.							
			No/low level in solvent recovery reactor	No HSE hazard/Process Delay	No existing safeguard.	3	1	3				
			Loadcell malfunctioning	Overflow may possible from top collection receiver	1.Loadcell calibration is performed before startup. 2.No open vent in collection receiver.so, no chances of overflow.	3	2	6				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Receiver vent is given in vacuum pot .so,no chances of overflow. 4.Material is compatible with utility.	3	3	9				
			Human error(Steam TCV more percentage open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.TI is available in distillation reactor with alarms.	3	1	3				
		Reverse	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	Human error(Manual valve of reflux line is fully open insted of collection line)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.							
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	No HSE hazard/Process Delay								
		High	No probable cause	No HSE hazard/Process Delay								
3	Temperature	Low	No probable cause									
		High	Utility failure in condenser	Temperature rise may possible in receiver	1.TI is available in receiver with high and high high alarms. 2.TI is available in utility supply and return line of condenser.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Receiver leakage	Fire hazard and health hazard due to spillage	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Loadcell is available in the collection receiver with low and low low alarms. 4.Thickness testing to be carried out as per PM schedule. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Human error (Withdrawal not done at regular interval)	Overflow may possible and lead to health hazard & fire	1.Loadcell is available on receiver with high and high high alarms. 2.Receiver vent line is	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC, Date:- 06-12-2019**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				hazard	connected with vacuum pot. so, overflow is not possible.							
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in MMBC storage tank(041ST-160)**										
1	Quantity/Flow	No/Less	Transferring/unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump running indication is provided on DCS. 2.LI is available in storage tank to monitor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Material receiving line Valve not opened)	No HSE hazard/Process delay								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available in tank low and low low alarm. 2.PM is performed before startup.	3	4	12				
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-							
		Low	PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12				
		High	PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation.	3	4	12				
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank	3	4	12	1.Double manual valve tyo be provide in N2 line.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high and high high alarm. 3.PVRV is available in tank.							
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC	3	3	9				
			Tank bottom valve passed/leakage									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					classification.							
		High	Refer high Flow									
5	Composition	Other than										
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure	No credible cause	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**Reaction in scrubber tank (040TK-252)**										
1	Quantity/Flow	No/Less	Scrubber circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS . 2.Vent line of scrubber column is given in secondary column. so, less chances of gas exposure.	3	3	9				
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up.	3	3	9				
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the	4	3	12				

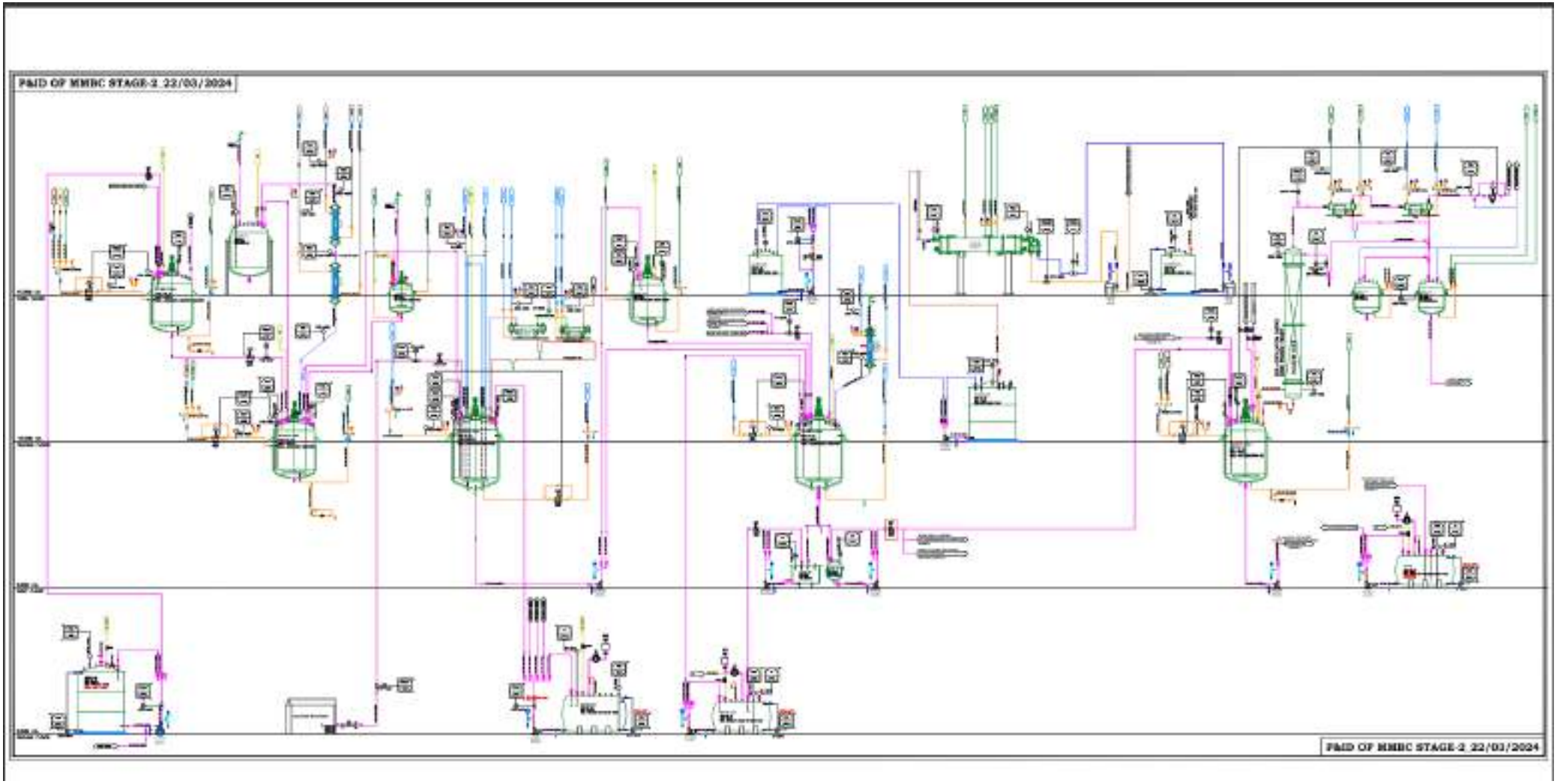
HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.							
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	No existing safeguard	3	3	9				
			NRV chocked in pump discharge line	Transferring line may pressurise and can lead to spillage/health hazard	Compatible MOC of NRV is used so chocking not possible.	2	3	6				
		High/More	Graphite condenser leakage	Scrubber tank may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Scrubber tank vent is given in scrubber column. so, no chances of overflow.	3	3	9				
			Circulation pump	No HSE hazard	1.Pump running	2	1	2				

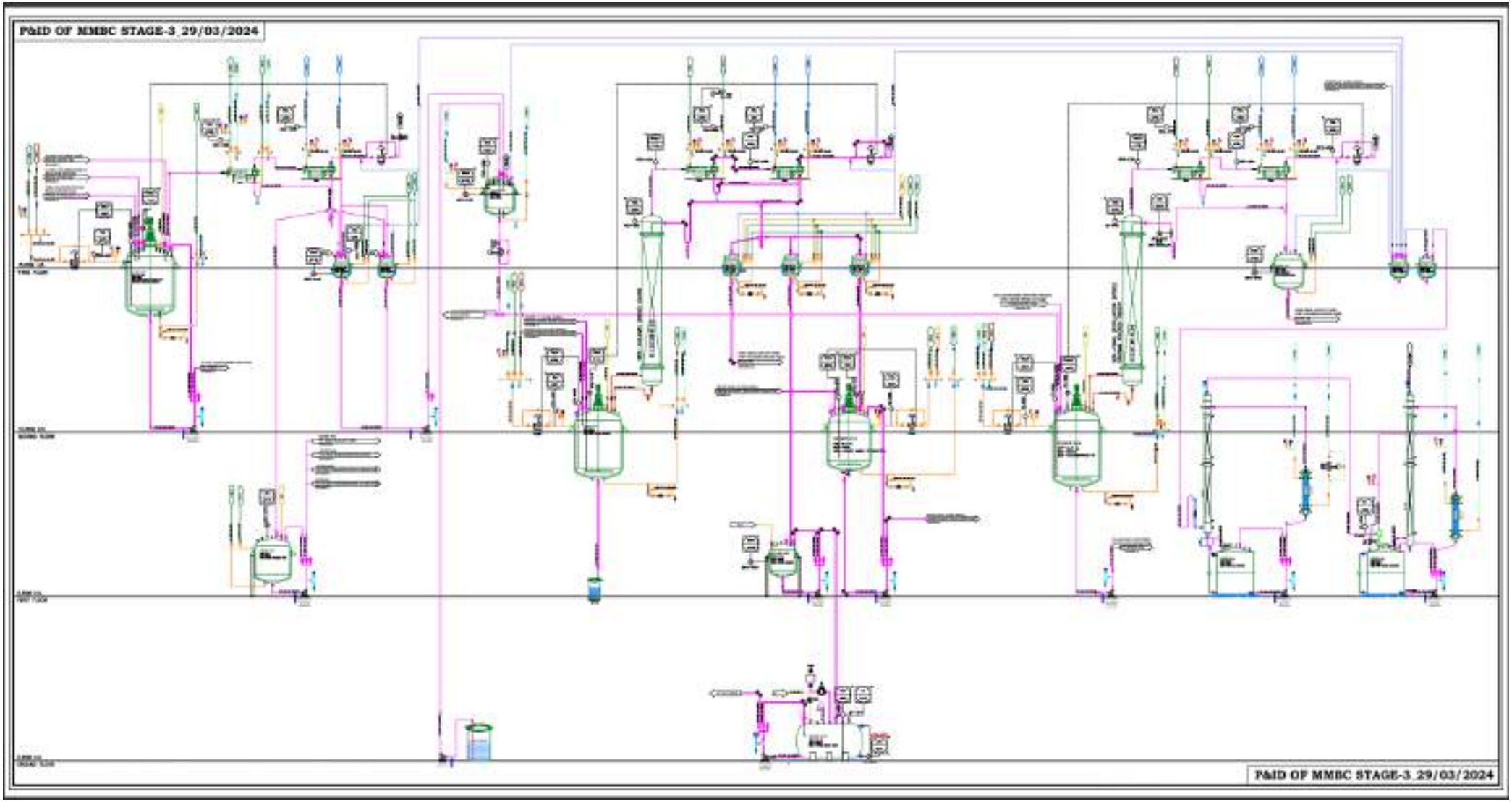
HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			run at high frequency		frequency is fixed after stabilize the process.							
		Reverse	Pump trip/stops	Pump mechanical failure	NRV is available in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-							
		Low	No probable cause	-	-							
2	Pressure	High	Vent line valve not opened (Human Error)	Scrubber tank may pressurise	1.PT is available on the tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar.	3	4	12				
			Caustic scrubber reactor circulation pump stop/trip		1.Pump running indication is available o DCS.	3	4	12				
			Venturi chocked		1.Material having no chocking property. 2.PM of venturi is performed before start operation.							

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No credible cause	-	TI is available in receiver with low and low low alarms							
		High	Utility failure in jacket of the tank Utility failure in jackt of the absorber column	Temperature rise may possible in scrubber tank	1.TI is available in HCl receiver with high and high high alarms. 2.TI is available in utility supply and return line of scrubber tank with alarms. 3.TI is available in utility return line of the absorber column.	3	4	12				
4	Level	Low	Refer low Flow									
		Low level in tank	Tank leakage	Gas/Liquid Exposure due to spillage	Receiver MOC is compatible so leakage is not possible	2	3	6				
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	2	3	6				
5	Composition	Other than	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC**						**Plant Name: Plant MMBC , Date:- 06-12-2019**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity		No HSE hazard								
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

APPENDIX-2: P&IDs



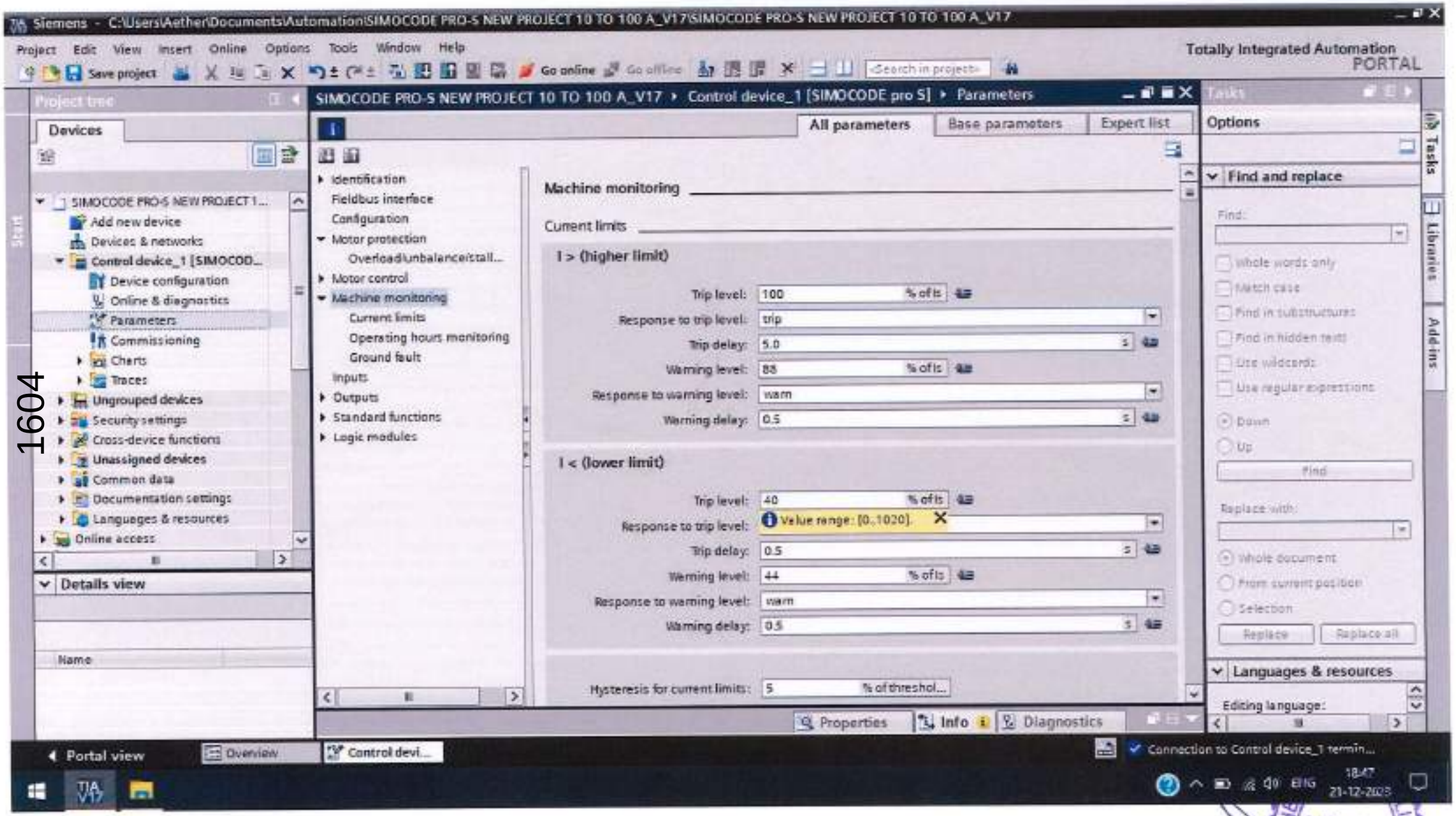


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MMBC HAZOP Recommendation Summary						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	MCT storage tank(040ST-145)	Material loading and unloading in MCT storage tank	Recommend to provide overload tripping on pump.	Electrical	Completed	1
2	Grignard addition reaction reactor(043RT-083)	MCT charging in grignard addition reactor (043RT-083)	Spill kit to be provided in nearby area to contain spillage.	Safety	Completed	2
3	Quenching reactor(041RT-095)	10% H2SO4 charging in quenching reactor (041RT-095)	Vent line valve should be locked open.	Mechanical	Completed	3
4	Chlorination reactor(042RT-104)	Thionylchloride addition from thionylchloride day tank(043TK-246) in chlorination reactor(042RT-104)	Flange guard to be provided on all flanges.	Mechanical	Completed	4
5	solvent recovery reactor(041RT-106)	Solvent recovery from solvent recovery reactor(041RT-106)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	5
6	Pure MMBC storage tank(041ST-160)	Material loading and unloading in MMBC storage tank(041ST-160)	Double manual valve tyo be provide in N2 line.	Mechanical	Completed	6





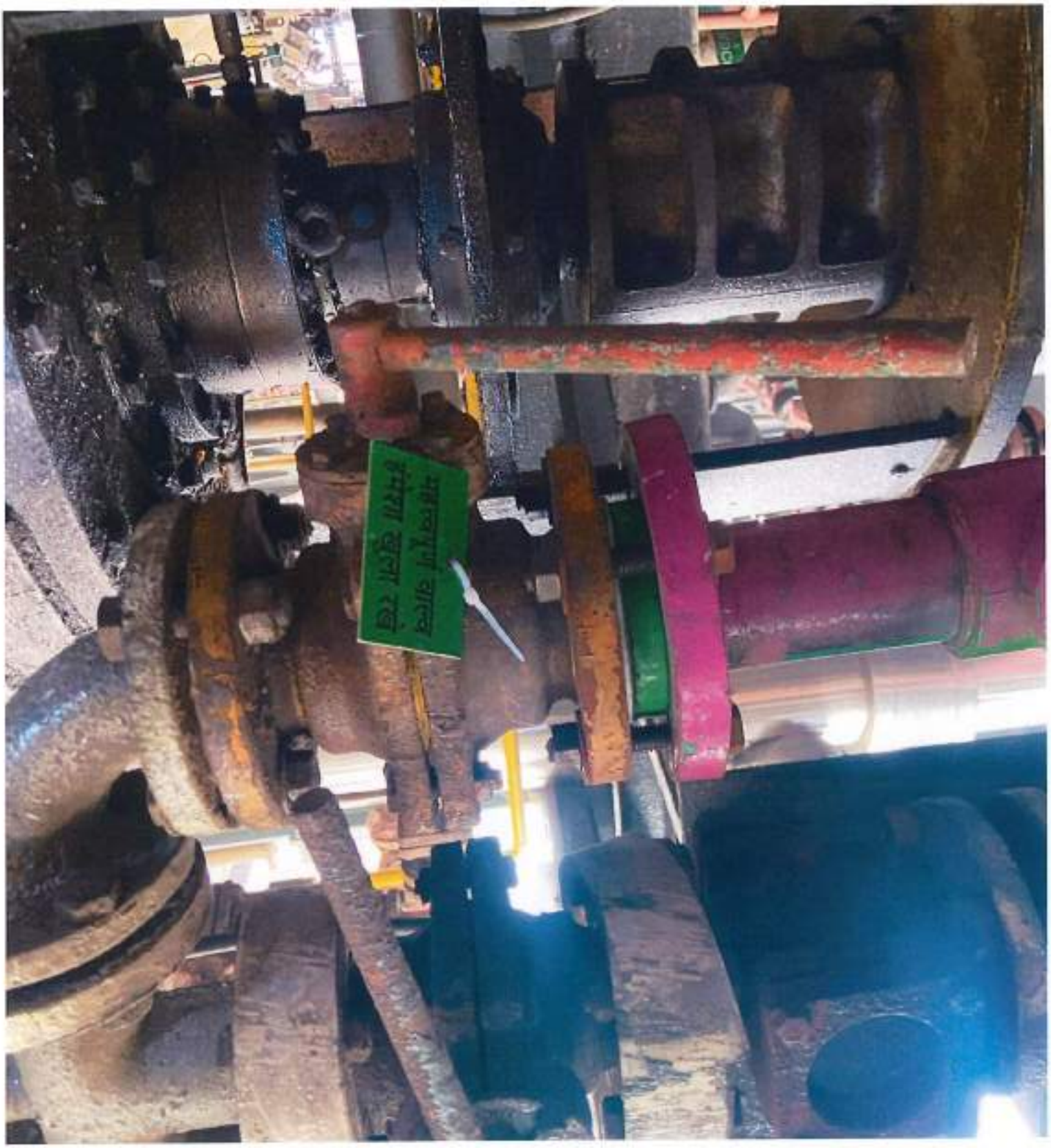
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HAZOP STUDY REPORT OF SOLVENT RECOVERY PLANT (SRP)

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

OCTOBER 2021

aether
elementally innovative



NEXA
Process Safety Engineers

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SURAT

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HAZOP STUDY REPORT OF

SOLVENT RECOVERY PLANT (SRP)

OCTOBER 2021

By

NEXA PROCESS SAFETY ENGINEERS

NEXA
Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

04/10/2021

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Project Solvent Recovery Plant (SRP).

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for SRP Project.
It has 5 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	Extraction Column (CM-05)
2.	Continuous Distillation Column (CM-01)
3.	Continuous Distillation Column (CM-02)
4.	Continuous Distillation Column (CM-03)
5.	Continuous Distillation Column (CM-04)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal

conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.

Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

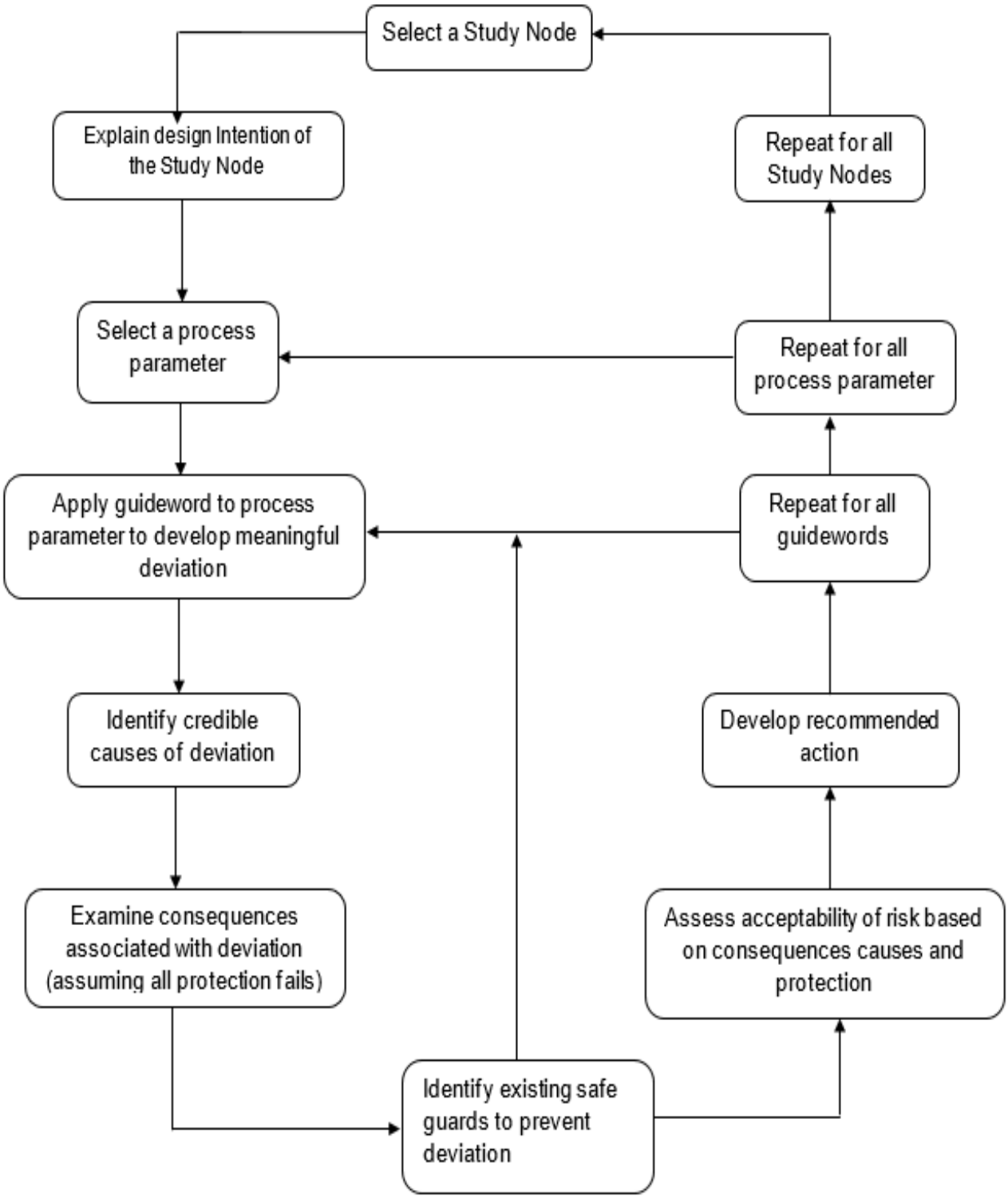
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:**But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:**Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	SRP_Plant-04

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

SRP HAZOP Recommendation Summary				
Sr No	**Node**	**Stream**	**Recommendations**	**Department**
1	Extraction Column (CM-05)	Continuous feeding from receiver (TK-01) to column (CM-05) through feeding pump (TP-010)	Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Mechanical
2	Continuous Distillation Column (CM-01)	Continuous feeding from receiver (TK-017) to distillation column (CM-01) through feeding pump (TP-017)	Flame arrestor PM to be carried out as per define schedule.	Mechanical
3			CV stroke testing to be carried out as per defined PM schedule.	Instrument
4	Continuous Distillation Column (CM-03)	Continuous feeding from receiver (TK-04) to distillation column (CM-03) through feeding pump (TP-012)	TCV bypass valve should be locked closed condition with tagging.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date-01/09/2021			
Node 1		Node Description : Extraction Column (CM-05)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from receiver (TK-01) to column (CM-05) through feeding pump(TP-010)										
1	Quantity/ Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2. Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in nearby area. 6.All electrical equipment are flameproof in nearby area.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	2	3	6
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	No HSE hazard	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line.	4	2	8				
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error (Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3. Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Mix solvent collection in receiver(TK-017)**										

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
13	Quantity/ Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.							

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Receiver may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms. 3. PVRV is available in the receiver.	4	3	12				
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from receiver (TK-017) to distillation column(CM-01) through feeding pump(TP-017)**										
1	Quantity /Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 2	**Node Description : Continuous Distillation Column (CM-01)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 2	**Node Description : Continuous Distillation Column (CM-01)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2	**Continuous distillation in distillation column (CM-01)**											
7	Quantity /Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12				
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					condenser line. 6.TI is provided in final vent line.							
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9				
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12				
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in	2	3	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					distillation column.							
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3				
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver (TK-05)**										

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
13	Quantity /Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9				
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so, there are no chances of incompatibility hazard.	3	3	9				
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before	4	3	12				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			not opened)		startup. 2. PT is available with HH alarms.							
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding to distillation column (CM-02) through feeding pump(CP-05-A/B)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up.	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3. Line is designed to resist maximum discharge pressure.							
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			Flow meter malfunctioning /Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-02)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-	No probable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		directed flow	cause									
8	Pressure	Low	No probable cause									
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12				
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9				
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12				
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3				
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver (TK-06)**										

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low alarm.	2	1	2				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9				
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so, there are no chances of incompatibility hazard.	3	3	9				
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH	4	3	12				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					alarms.							
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal in receiver (TK-04)**										
19	Quantity/Flow		Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV	No HSE hazard/Proces								

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			stuck	s Delay								
			Vent line valve is not open	No HSE hazard/Process Delay								
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3				
		High/More	Bottom collection CV passed	Overflow may possible	1.LI is available in receiver with high and high high alarm.	3	3	9				
			Bypass valve of CV passed/left open									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup.	4	3	12				
			Flame arrestor chocked in vent line		1.Material having no chocking property.	3	3	9				
21	Temperature	Low	No probable cause									
		High	No probable cause									
22	Level	Low	Tank leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI is available in the tank with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date-01/09/2021			
Node 4		Node Description : Continuous Distillation Column (CM-03)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from receiver (TK-04) to distillation column(CM-03) through feeding pump(TP-012)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			line of column is not opened)		ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.							
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning /Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Wrong set point of feed flow is given in	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm.	4	2	8				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			feeding line mass flow meter)		2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.							
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static	-	Fire hazard	1. Double earthing is	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Electricity			provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-03)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		flow										
8	Pressure	Low	No probable cause	Distillation column may pressurize								
		High	Human error (Vent line manual valve is closed)		1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12				
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9				
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					line.							
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9				
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3				
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3				
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver (TK-07)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			not open)									
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9				
			Top collection	No HSE								

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			line CV stuck	hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	3	3	9				
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12				
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding to distillation column (CM-04) through feeding pump(CP-07-A/B)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up.	3	2	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3. Line is designed to resist maximum discharge pressure.							
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9				
			Flow meter malfunctioning /Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error (Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-04)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error(Vent line	Distillation column may	1.Trained manpower will operate the operation and	4	3	12				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			manual valve is closed)	pressurize	ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.							
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9				
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9				
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck	Temperature rise may	1.PM is performed of TCV before start up.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			open	possible in column	2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12				
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top, middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3				
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3				
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so, no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(TK-08)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6.TI is provided in final vent line.							
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so, there are no chances of incompatibility hazard.	3	3	9				
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12				
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9				
			Bottom valve pass/leakage		No existing safeguard	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date-01/09/2021**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

|| END OF THE REPORT ||

SRP HAZOP Recommendation Summary						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	Extraction Column (CM-05)	Continuous feeding from receiver (TK-01) to column(CM-05) through feeding pump(TP-010)	Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Mechanical	Completed	1
2	Continuous Distillation Column (CM-01)	Continuous feeding from receiver (TK-017) to distillation column(CM-01) through feeding pump(TP-017)	Flame arrestor PM to be carried out as per define schedule.	Mechanical	Completed	2
3			CV stroke testing to be carried out as per defined PM schedule.	Instrument	Completed	3
4	Continuous Distillation Column (CM-03)	Continuous feeding from receiver (TK-04) to distillation column(CM-03) through feeding pump(TP-012)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	4

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 25/08/2021 Equipment TAG No : TK-017 Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	Tightning done	—	✓	Sandeep
2	Check visual condition of flame element	found OK	—	✓	Sandeep
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleaned with N_2	—	✓	Sandeep
4	Visually check Gasket condition	checked OK	—	✓	Sandeep
Note:-					

Checked by MD

15/08/2021

Checked By PD

15/08/2021

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MONTHLY CONTROL VALVE STOCK CHECK SCHEDULE (PSM-F01)

SR NO.	PLANT NAME	TAG NO.	SERVICE	CONTROL VALVE OPENING STATUS FROM DCS				DATE	DONE BY	CHECK BY	REMARKS
				25%	50%	75%	100%				
1.	Plant-4	3TIC1-4274	THF Column Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
2.	Plant-4	2TIC1-4367	T.I. Column Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
3.	Plant-4	3TIC1-4398	I.B Column Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
4.	Plant-4	3TIC1-4401	Flash Drum Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
5.	Plant-4	3TIC-0-4629	Purge Distillation Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
	CPP	3TICO-4114	Cont. Chm 1 Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
	CPP	3TIC1-2115	Cont. Chm 2 Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
	CPP	3TICO-4143	Cont. Chm 3 Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-
	CPP	3TICO-4155	Cont. Chm 4 Temp CV.	24%	50%	74%	100%	18/12/2023	Mihir	[illegible]	-

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HAZOP STUDY REPORT OF

4 TACH PRODUCT

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

DECEMBER 2021

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NEXA
Process Safety Engineers

1704

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

HAZOP STUDY REPORT OF

4 TACH PRODUCT

DECEMBER 2021

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel and his team and all other Head of the departments of respective plant for speedy completion of this report.

Surat





Proprietor

12-12-2021 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation.
- To identify significant operating or quality problems.
- To identify practical problems associated with maintenance operation.

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for 4TACH project.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management. The participants had a significant amount of experience in the Process Safety

Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well known as well as the required control measures to reduce risk to acceptable levels.

During the study, Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 Scope

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for 4TACH project. It was divided in to following 16 nodes as below:

NODE NO.	NODE DESCRIPTION
1.	Pure IPA storage tank (040ST-166)
2.	Slurry reactor (043RT-111)
3.	Catalyst reactor (043RT-113)
4.	Autoclave (043RT-112)
5.	IPA recovery reactor (043RT-088)
6.	Crude Crystallizer (042RT-093)
7.	041ANFD-009
8.	Separation storage tank (041ST-132)
9.	Aqueous storage tank (040ST-157)
10.	S-2 Purification reactor (042RT-087)
11.	041ANFD-008
12.	Coupling Reactor (042RT-094)
13.	041ANFD-010
14.	ANFD ML storage tank (040ST-148)
15.	S-2 Toluene recovery reactor(043RT-096)
16.	Recovered AESOL-T tank (040ST-149)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 Methodology

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other’s ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.

5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although

it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material.

PARAMETER	TYPICAL DEVIATION	EXPLANATION
		Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50 yr	Once in 10 to 50 yr	Once in 1 to 10 yr	Once a year	More than once in a year

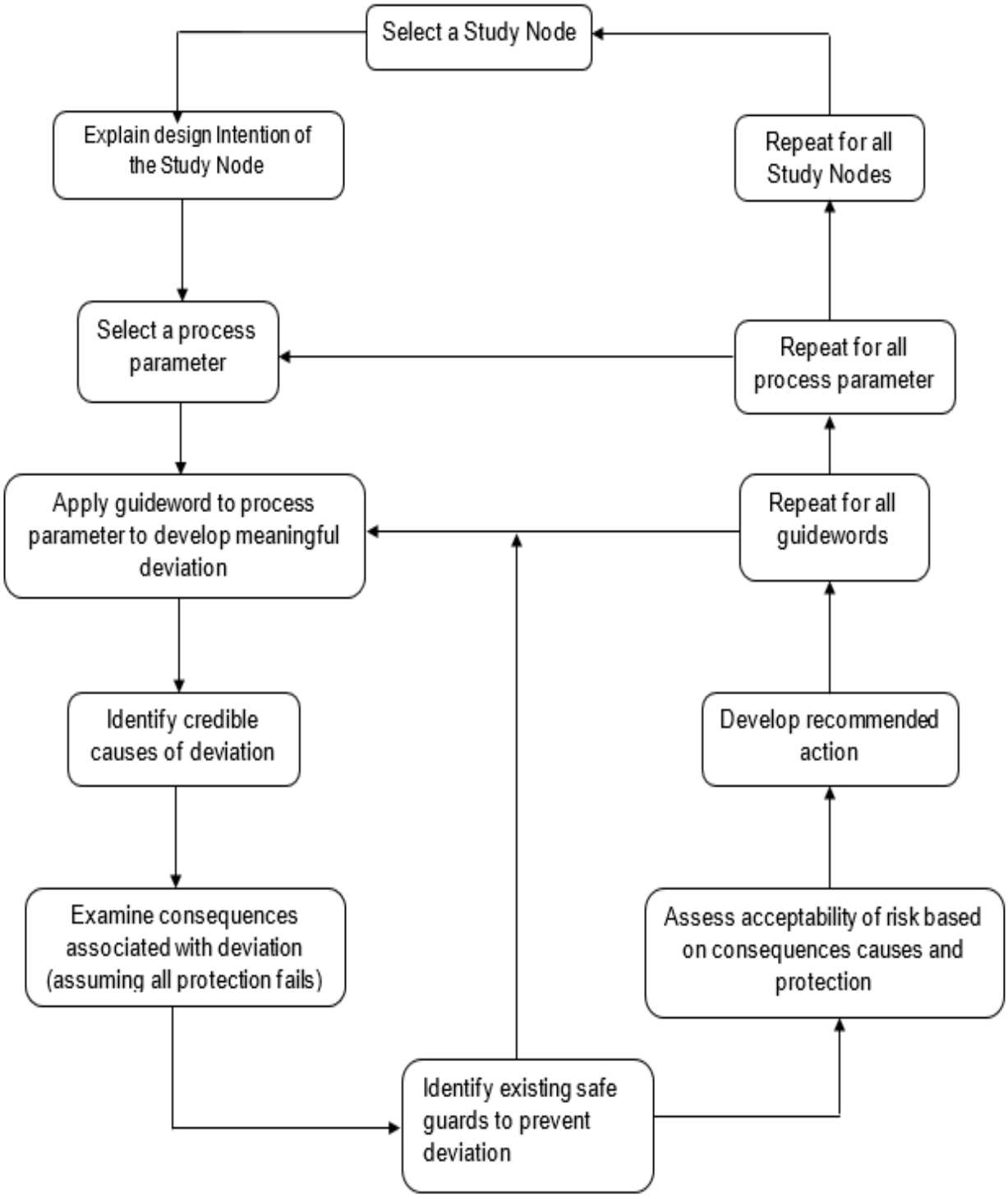
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS MH 1-2 ≤0.5kg GHS MH 3-5 ≤5kg Other GHS ≤5kg	GHS MH 1-2 0.5-5kg; GHS MH 3-5-1-100kg,	GHS MH 1-2 >5kg GHS MH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern. Near Miss (High Potential)	Medical Treated case (Restricted Work / Lost Work) – Non-Reportable. Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to meet where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum / vent / process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	PI & D / SOPS / MSDS	8203/4TACH-STAGE-1/001 & Stage 2

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet.
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working

days of the completion of the plant HAZOP.

- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. Akhilkumar Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. Akhilkumar Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal- Electrical Mr. Smit Desai- Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team Members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION/ SPECIFIC REMARKS

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore, the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendations are summarised as below:

4TACH HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	Pure IPA storage tank(040ST-166)	Material loading and unloading in IPA storage tank	Recommend to provide overload tripping on pump.	Electrical
2	Autoclave(043RT-112)	Hydrogenation reaction	TCV bypass valve should be locked closed condition with tagging.	Mechanical
3		Filtration in candle filter(042CF-002)	Spill kit to be provided in the nearby area to contain spillage.	Safety
4	Crude Crystalizer (042RT-093)	Heating & Maintaining in crude crystalizer (042RT-093)	PM of flame arrestor is performed as per predefined schedule	Mechanical
5	Separation storage tank(041ST-132)	Material loading and unloading in separation storage tank	Recommend to provide double valve provision to prevent valve passing/leakage.	Mechanical
6	Aqueous storage tank(040ST-157)	Aqueous storage tank(040ST-157)	Vent line manual valve to be in critical locked open condition with LO tag.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed, and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved

operability and maintainability" categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please refer to column entitled "Action Tracking" in the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for **M/s Aether Industries Ltd., Surat**. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with **M/s Aether Industries Ltd., Surat**.

APPENDIX-1: HAZOP MINUTES

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in IPA storage tank**										
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.Flow meter is available in material transferring line . 3.LI is available in storage tank to motor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				spillage/health hazard	discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12				
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	3	3	9				
			Tank bottom valve passed/leakage		3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Composition	Other than	Wrong material supplied from vendor	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before tanker unloading start.	2	3	6				
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**IPA charging in slurry reactor(043RT-111) from IPA storage tank(040ST-166)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of IPA tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	3	1	3				
			Human error (manual valve of IPA receiving line of slurry reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard								
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	3	3	9				
			Human error (Circulation line valve open/pass) in storage tank	Process delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				
			Low level in storage tank	No HSE hazard/Process Delay	1. LI is available in the tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health & fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so, no chances of overflow.	3	3	9				
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human Error (During IPA charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12				
3	Temperature	Low	No probable cause									
		High	TCV failure/stuck	Temperature rise may	1.PM is performed of TCV before start up.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			open	possible in the reactor	2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.							
			Human error (TCV bypass line passed/open)		No existing safeguard	3	4	12				
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	2	6				
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**Powder charging in slurry reactor(043RT-111)**										
7	Quantity/Flow	No/Less	Human error (Less quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		High/More	Human error (More quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
			No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
9	Temperature	Low	No credible cause									
		High	No credible cause									
10	Level	Low	Refer low Flow									
		High	Refer high Flow									
11	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor . 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Leakage spillage		No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 2		**Node Description : Slurry reactor(043RT-111)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					the same periodically.							
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 3		**Node Description : Catalyst reactor(043RT-113)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Catalyst charging in catalyst reactor(043RT-113)**										
1	Quantity/Flow	No/Less	Human error (Less quantity of Catalyst charged)	No HSE hazard/Process delay	1.Batch wise fix charging quantity of catalyst will be issued from the store to prevent human error. 2.Loadcell is available on catalyst reactor.	3	2	6				
		High/More	Human error (More quantity of Catalyst charged)	No HSE hazard/Process delay	1.Batch wise fix charging quantity of catalyst will be issued from the store to prevent human error. 2.Loadcell is available on catalyst reactor.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	No probable cause									
			No probable cause									
3	Temperature	Low	No credible cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 3		**Node Description : Catalyst reactor(043RT-113)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the tank.	3	3	9				
		Leakage spillage		Fire hazard	1.Trained manpower will perform the catalyst charging activity. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 3		**Node Description : Catalyst reactor(043RT-113)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Hydrogenation reaction**										
1	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard								
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High/More	High pressure of N2 in N2 line	No HSE hazard								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	Leakage from the reactor	Fire hazard	1. Hydrogen detector is available to detect leakages with high and high alarms. 2. Interlock is available to stop hydrogen supply line ROV & PCV in case of H2 detector high high value. 3. Interlock is also available to stop steam TCV in case of high high value of H2 detector. 4. PT is available to monitor pressure in the reactor. 5. Pressure test is being carried out before starting batch.	3	3	9				
		High	Hydrogen supply pressure high	Reactor may pressurize	1. H2 PRS system available to supply required pressure. 2. PCV available to supply H2 pressure in reactor. 3. ROV is available in the H2 supply line. 4. PT is available in the reactor with high and high high alarm. 5. Interlock is available to stop ROV and PCV in case of	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high high pressure of reactor. 6. PT is available in the H2 supply line with high and high high alarms. 7. Interlock is also available to stop ROV and PCV of H2 supply line on high high value of H2 supply line PT. 8. RD and PSV is available on reactor with discharge is connected with dump tank. 9. ROV is available in separate vent line on reactor connected with dump tank.and open at HH pressure of the reactor. 10. Nitrogen inertisation is provided in the dump tank.							
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	3	4	12				
3	Temperatu	Low	Human Error	No HSE		0	0	0				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	re		(Cooling started instead of heating)	hazard.								
		High	H2 supply pressure high	Exotherm may possible in the reactor	1. TT is available in the reactor with high and high high alarms. 2. Interlock is available to close TCV of steam supply line on high high value of TI of the reactor. 3. TI also available in steam supply line with high and high high alarms. 4. Interlock is available to close steam supply line TCV in case of supply line TT temperature high high value. 5.Interlock is available to close the steam supply line TCV at HH value of PT of H2 supply line.	3	4	12				
			TI malfunction		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	Refer low Flow			0	0	0				
		High	Refer low Flow			0	0	0				
			Jacket puncture of the reactor	Reactor may overflow and chances of	Before startup spark test & thickness testing is performed.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Tube bundle leakage in reactor	spillage/leakage	PM of tube bundle is performed before startup.	3	3	9				
5	Others	Static charge	Venting rate high during H2 venting	Fire hazard	1. CV is available in the vent line to maintain venting rate 0.5 bar/min. 2. N2 flushing is also done while H2 venting. 3. Flowmeter is available in the N2 line to ensure nitrogen flow during venting. 4. Low and low low alarm available with N2 flowmeter. 5. Interlock is available to stop CV of H2 venting line in case of nitrogen supply flowmeter low low value. 6. Steam snuffing is available at the end of the vent line with sprager. 7. Endurance burning RTD with flame arrestor is available in the vent line. 8. Catch pot is available with water for venting of hydrogen.	4	3	12				0

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power failure	GEB power failure	Runaway may possible	DG backup is provided to all critical equipments.	3	3	9				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Decoupling	Runaway may possible	1. No load tripping available in case agitator decoupling. 2. Interlock is available to stop H2 supply line ROV, PCV and steam supply line TCV in case of agitator decoupling.	3	3	9				
Stream -2		**Filtration in candle filter(042CF-002)**										
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard/Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6.Fire extinguisher and fire hydrant point is available near by area.							
			Human Error (Manual valve of autoclave to filter transferring line is closed)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				
			No/low level in autoclave	No HSE hazard/Process Delay	No existing safeguard.	3	1	3				
			Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line pressure is maintain 3 kg/cm2.	3	1	3				
		High/More	High pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line maximum pressure is maintain up-to 3 kg/cm2.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
7	Pressure	Low	Low pressure in N2 line	No HSE hazard/Proces	1.PT is available in N2 buffer tank.	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				s Delay	2.N2 line pressure is maintain 3 kg/cm2. 3.PT is available in candle filter with low and low low alarm.							
		High	High pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line maximum pressure is maintain up-to 3 kg/cm2. 3.PT is available in candle filter with high and high alarm.	3	1	3				
8	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
9	Level	Low	Body leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1.Filter design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve to be provide to prevent valve passing.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage.	2	3	6

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 10-11-2021**			
Node 4		**Node Description : Autoclave(043RT-112)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture of the filter	Overflow may possible from filter and lead to fire & health hazard	1.Fire hydrant point & extinguisher is available in near by area. 2.All electrical installation are flameproof as per HAC classification. 3.Thickness testing to be performed before startup.	3	3	9				
10	Composition	Other than	No probable cause									
11	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 5		**Node Description : IPA recovery reactor(043RT-088)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**solvent recovery from IPA recovery reactor(043RT-088)**										
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9				
			Sample	Health and fire	1.Fire extinguisher and fire	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 5		**Node Description : IPA recovery reactor(043RT-088)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			point/Drain point manual valve pass	hazard due to spillage	hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.							
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor with high and high high alarms.	3	4	12				
		High Vacuum	No probable cause	No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 5		**Node Description : IPA recovery reactor(043RT-088)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor with high and high high alarms.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error(TCV bypass line		No existing safeguard	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 5		**Node Description : IPA recovery reactor(043RT-088)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			passed/open)									
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	12				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and chances of spillage/leakage	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transferring line	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 5		**Node Description : IPA recovery reactor(043RT-088)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 6		**Node Description : Crude Crystallizer (042RT-093)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Heating & Maintaining in crude crystallizer (042RT-093)**										
1	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard		3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay		3	1	3				
		High/More	High pressure of N2 in N2 line	No HSE hazard								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 6		**Node Description : Crude Crystallizer (042RT-093)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 6		**Node Description : Crude Crystallizer (042RT-093)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Manual vent valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	3	4	12				
			Flame arrestor chocked		PM of flame arrestor is performed before startup	3	4	12	PM of flame arrestor is performed as per predefined schedule	2	4	8
3	Temperature	Low	Human error(Brine supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 6		**Node Description : Crude Crystallizer (042RT-093)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	3	4	12				
4	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9				
			Reactor bottom valve passed		1.Compatible MOC of valve is used at bottom of the reactor.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 6		**Node Description : Crude Crystallizer (042RT-093)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Reactor Leakage		Reactor MOC is compatible with material.	3	3	9				
		High	Jacket puncture of the reactor & condenser leakage	Reactor may overflow and material incompatible hazard may possible	1.MOC is compatible with material. 2.PG is available in utility return line. 3.No incompatible hazard with reaction mass& utility in case of jacket puncture.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transferring line	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Proces	Battery bank backup is provided and PM is done for	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 6		**Node Description : Crude Crystallizer (042RT-093)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				s Delay	the same periodically.							
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 7		**Node Description : 041ANFD-009**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Filtration & Drying in 041ANFD-009**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	Nitrogen supply line valve pass	1.Ml transferring line may pressurise and leakage 2.Fire hazard due to spillage	1.Trained manpower will operate. 2.PT is available in ANFD with high and high high alarms. 3.Line pressure testing is being performed before start-up. 4.PRV is also available in N2 supply line. 5.N2 supply maximum pressure is upto 3 bar. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 7		**Node Description : 041ANFD-009**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the ANFD	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the ANFD with high and high high alarms. 5. TI is available in the ANFD with high and high high alarms.	3	4	12				
		High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in ANFD with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.ANFD design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 7		**Node Description : 041ANFD-009**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.Double valve is provided in N2 supply line							
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard		3	1	3				
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the ANFD with high and high high alarms.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 7		**Node Description : 041ANFD-009**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	ANFD leakage, MI transferring line valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. ANFD design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		High	Refer high									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 7		**Node Description : 041ANFD-009**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the ANFD. 2. Double earthing/grounding is provided to the ANFD. 3. Antistatic scrapper is used for unloading,	3	3	9				
		Leakage spillage	Human error	Fire hazard Health Hazard	1.Line testing is performed before start-up. 2.Spill kit is available in the plant to 3.contain spillage in case of leakage. 4.Cartridge mask & PVC suit is used while filling powder.	3	3	9				
		Instrument Air failure	Air compressor failure	ANFD may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to	Runaway may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 11-11-2021			
Node 7		Node Description : 041ANFD-009										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			mechanical failure		case of agitator stop/trip.							

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 8		**Node Description : Separation storage tank(041ST-132)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in separation storage tank**										
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.LI is available in storage tank to motor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 8		**Node Description : Separation storage tank(041ST-132)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 8		**Node Description : Separation storage tank(041ST-132)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 8		**Node Description : Separation storage tank(041ST-132)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.PVRV is available in tank.							
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12				
			N2 line	Tank may	1.PRV is available in N2 line.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 11-11-2021**			
Node 8		**Node Description : Separation storage tank(041ST-132)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			manual valve pass	pressurise	2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.							
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	3	3	9				
			Tank bottom valve passed/leakage		3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Compositio	Other										

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 11-11-2021**			
Node 8		**Node Description : Separation storage tank(041ST-132)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	n	than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 9		**Node Description : Aqueous storage tank(040ST-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Aqueous storage tank (040ST-157)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard	1.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9				
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 9		**Node Description : Aqueous storage tank(040ST-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	Wrong line up(Manual valve or pump start of organic tank instead of aqueous tank line up)	No HSE hazard					-			
2	Pressure	Low	Human error (Storage tank vent valve is	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before	3	4	12	1. Vent line manual valve to be in critical locked open	2	4	8

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 9		**Node Description : Aqueous storage tank(040ST-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			not open) during unloading		start-up.				condition with LO tag.			
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	PM of flame arrestor is performed before startup.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in tank with low and low low alarms							
		High	No credible cause	-	TI is available in tank with high and high high alarms.							
4	Level	Low	Refer low Flow									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 9		**Node Description : Aqueous storage tank(040ST-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	3	3	9				
			Tank bottom valve passed/leakage		1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Composition	Other than										
6	Others	Static Electricity	-									
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Toluene charging in S-2 purification reactor(042RT-087) from storage tank**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of toluene tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	3	1	3				
			Human error (manual valve of toluene receiving line of S-2 purification reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard								
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.							
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	3	3	9				
			Human error (Circulation line valve open/pass) in storage tank	Process delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				
			Low level in storage tank	No HSE hazard/Process Delay	1. LI is available in the tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				
		High/More	Human error (Wrong input in flow meter/totaliser)	Overflow from reactor and lead to spillage/health & fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser .so, no chances of overflow.	3	3	9				
		Reverse	Pump trip/stop	Pump mechanical	1.NRV is provided in pump discharge line.	3	2	6				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				failure								
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human Error (During toluene charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12				
			Flame arrestor chocked		PM of flame arrestor is performed before startup.	3	4	12				
3	Temperature	Low	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in the reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is	3	2	6				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					available.							
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**S-1 powder charging in S-2 purification reactor(042RT-087)**										
7	Quantity/Flow	No/Less	Human error (Less quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		High/More	Human error (More quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
			No probable cause									
9	Temperature	Low	No credible cause									
		High	No credible cause									
10	Level	Low	Refer low Flow									
		High	Refer high Flow									
11	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor . 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Leakage spillage		No HSE hazard								
		Instrument Air	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		failure										
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-3		**Heating & reflux in S-2 purification reactor(042RT-087)**										
12	Quantity/Flow	No/Less	Refer low flow of stream 1&2			3	1	3				
		High/More	Refer high flow of stream 1&2									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
13	Pressure	Low	No probable cause	-	-				-			

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12				
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Manual vent valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	3	4	12				
			Flame arrestor chocked		PM of flame arrestor is performed before startup	3	4	12				
14	Temperature	Low	Human error(Cooling water supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	3	4	12				
15	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9				
			Reactor bottom valve		1.Compatible MOC of valve is used at bottom of the reactor.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			passed									
			Reactor Leakage		Reactor MOC is compatible with material.	3	3	9				
		High	Jacket puncture of the reactor & condenser leakage	Reactor may overflow and material incompatible hazard may possible	1.MOC is compatible with material. 2.PG is available in utility return line. 3.No incompatible hazard with reaction mass& utility in case of jacket puncture.	3	3	9				
16	Composition	Other than	No probable cause									
17	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transfering line	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 11		**Node Description : 041ANFD-008**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Hot Filtration in ANFD(041ANFD-008)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	Nitrogen supply line valve pass	1.Ml transferring line may pressurise and leakage 2.Fire hazard due to spillage	1.Trained manpower will operate. 2.PT is available in ANFD with high and high high alarms. 3.Line pressure testing is being performed before start-up. 4.PRV is also available in N2 supply line. 5.N2 supply maximum pressure is up to 3 bar. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 11		**Node Description : 041ANFD-008**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error (Vent line/vapour line valve not opened)	ANFD may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in ANFD with high and high high alarm. 3.ANFD design pressure is up to 6 bar. 4.Interlock is provided to closed the steam TCV at HH value of PT of the ANFD.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in ANFD ensure before startup that valve is open condition. 5.PT is available in ANFD with high and high high alarm.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 11		**Node Description : 041ANFD-008**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard		2	2	4				
		High	Human error(Steam line valve open/passes)	Exotherm may possible in ANFD	1.TI is available in ANFD with high and high alarm. 2.Trained manpower is deputed for operation. 3.Double valve is available in steam line.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 11		**Node Description : 041ANFD-008**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	ANFD leakage, MI transferring line valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. ANFD design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the ANFD. 2. Double earthing/grounding is provided to the ANFD. 3. Antistatic scrapper is used for unloading,	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 11		**Node Description : 041ANFD-008**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Leakage spillage	Human error	Fire hazard Health Hazard	1.Line testing is performed before start-up. 2.Spill kit is available in the plant to 3.contain spillage in case of leakage. 4.Cartridge mask & PVC suit is used while filling powder.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 12		**Node Description : Coupling Reactor(042RT-094)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Crystallization in coupling reactor(042RT-094)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of sparkler filter is not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flange guard is provided in transferring line. 3.Line pressure test is performed before startup.	3	1	3				
			Human error (manual valve of ML receiving line on coupling reactor is not opened).									
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 12		**Node Description : Coupling Reactor(042RT-094)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	3	3	9				
			Low level in ANFD-008	No HSE hazard/Process Delay	No existing safeguard	3	1	3				
		High/More	No probable cause									
		Reverse	Pump trip/stop	Pump mechanical failure	1.NRV is provided in pump discharge line.	3	2	6				
		Mis-directed flow	Wrong line-up (Line up in ANFD in place of coupling reactor)	No HSE hazard/Process delay								
2	Pressure	Low	No probable cause									
		High	Human Error (Vent line/vapour line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 12		**Node Description : Coupling Reactor(042RT-094)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4. Reactor design pressure is 6 bar.							
			Flame arrestor chocked		PM of flame arrestor is performed before startup.	3	4	12				
3	Temperature	Low	No probable cause									
		High	Human error(steam line manual valve open passed)	Temperature rise may possible in the reactor	1.TI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation.	3	4	12				
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	2	6				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 12		**Node Description : Coupling Reactor(042RT-094)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 13		**Node Description : 041ANFD-010**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Filtration & Drying in 041ANFD-010**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	Nitrogen supply line valve pass	1.MI transferring line may pressurise and leakage 2.Fire hazard due to spillage	1.Trained manpower will operate. 2.PT is available in ANFD with high and high high alarms. 3.Line pressure testing is being performed before start-up. 4.PRV is also available in N2 supply line. 5.N2 supply maximum pressure is up to 3 bar. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 13		**Node Description : 041ANFD-010**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the ANFD	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the ANFD with high and high high alarms. 5. TI is available in the ANFD with high and high high alarms.	3	4	12				
		High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in ANFD with high and high high alarm.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 13		**Node Description : 041ANFD-010**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.ANFD design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard		3	1	3				
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the ANFD with high and high high alarms.	3	4	12				
			TCV failure/stuck		1.PM is performed of TCV before start up.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 12-11-2021**			
Node 13		**Node Description : 041ANFD-010**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			open		2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	ANFD leakage, MI transferring line valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. ANFD design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 13		**Node Description : 041ANFD-010**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					the nearby area to contain spillage. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.							
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the ANFD. 2. Double earthing/grounding is provided to the ANFD. 3. Antistatic scrapper is used for unloading,	3	3	9				
		Leakage spillage	Human error	Fire hazard Health Hazard	1.Line testing is performed before start-up. 2.Spill kit is available in the plant to 3.contain spillage in case of leakage. 4.Cartridge mask & PVC suit is used while filling powder.	3	3	9				
		Instrument Air failure	Air compressor failure	ANFD may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 12-11-2021**			
Node 13		**Node Description : 041ANFD-010**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 14		**Node Description : ANFD ML storage tank(040ST-148)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in ANFD ML storage tank**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard								
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12				
			Flame arrestor	Tank may implode	1. Trained manpower will perform unloading activity	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 14		**Node Description : ANFD ML storage tank(040ST-148)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			chocked (Storage tank vent line)		and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.							
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-							
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12				
			Flame arrestor	Tank may implode	1. Trained manpower will perform unloading activity	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 14		**Node Description : ANFD ML storage tank(040ST-148)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			chocked (Storage tank vent line)		and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.							
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm.	3	4	12				
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.Local vent is provided in storage tank.	3	4	12				
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.Local vent is provided in storage tank.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 14		**Node Description : ANFD ML storage tank(040ST-148)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Tank bottom valve passed/leakage									
		High	Refer high Flow									
5	Composition	Other than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air		No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 14		**Node Description : ANFD ML storage tank(040ST-148)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		failure										
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 15		**Node Description : S-2 Toluene recovery reactor(043RT-096)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**S-2 Toluene recovery reactor(043RT-096)**										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9				
			Sample point/Drain	Health and fire hazard due to	1.Fire extinguisher and fire hydrant point is available in	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 15		**Node Description : S-2 Toluene recovery reactor(043RT-096)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			point manual valve pass	spillage	near by area. 2.All electrical installation are flameproof as per HAC classification.							
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor with high and high high alarms.	3	4	12				
		High Vacuum	No probable cause	No HSE hazard								

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 15		**Node Description : S-2 Toluene recovery reactor(043RT-096)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor with high and high high alarms.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error(TCV		No existing safeguard	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 15		**Node Description : S-2 Toluene recovery reactor(043RT-096)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			bypass line passed/open)									
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	12				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		High	Jacket puncture of the reactor	Reactor may overflow and chances of spillage/leakage	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 15		**Node Description : S-2 Toluene recovery reactor(043RT-096)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					solvent transferring line							
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12				
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 16		**Node Description : Recovered AESOL-T tank (040ST-149)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in AESOL-T storage tank**										
1	Quantity/Flow	No/Less	Line/Flange leakage Human Error (Discharge Valve not opened)	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12				

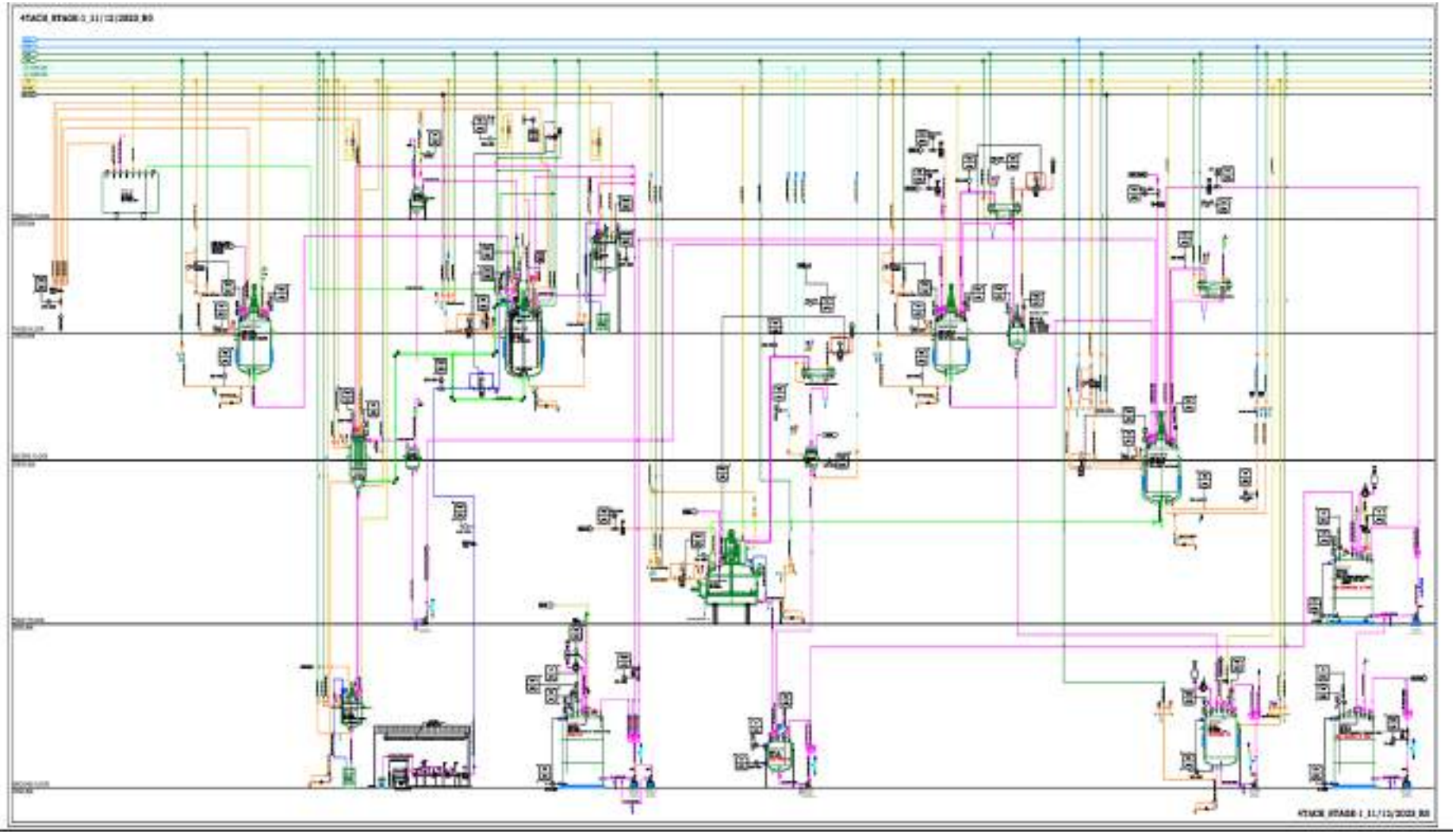
HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 16		**Node Description : Recovered AESOL-T tank (040ST-149)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.PVRV is available in tank.							
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12				
			Flame arrestor chocked (Storage tank	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12				

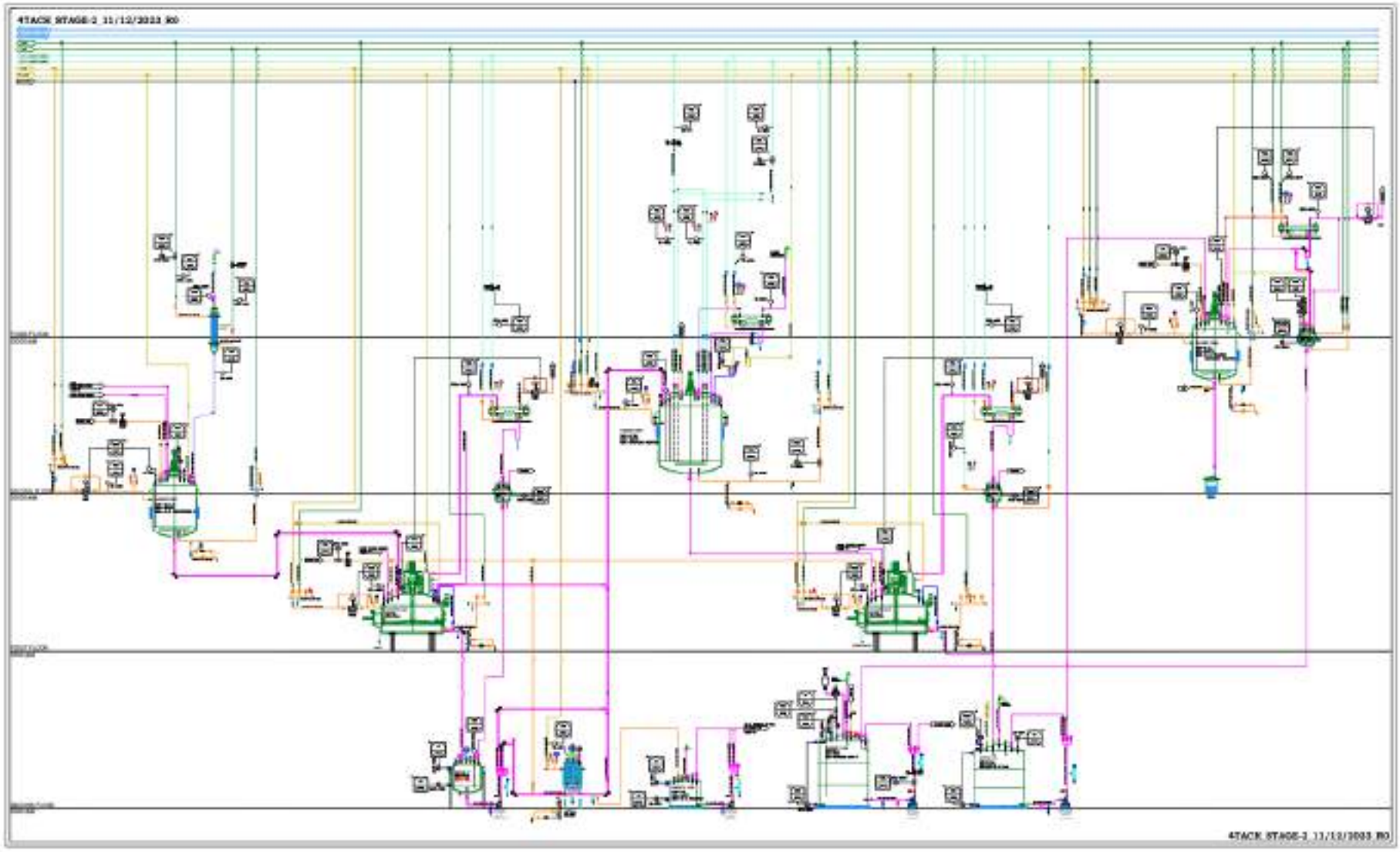
HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 16		**Node Description : Recovered AESOL-T tank (040ST-149)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			vent line)		2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.							
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12				
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12				
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001			**Title : HAZOP Study Of 4TACH**						**Plant Name: Plant-4, Date- 13-11-2021**			
Node 16		**Node Description : Recovered AESOL-T tank (040ST-149)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12				
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12				
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12				
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to	1. Tank MOC is compatible with material. so leakage is	3	3	9				

HAZOP study of 4TACH Project at 8203 Site												
P &ID number : 8203/4TACH-STAGE-1/001		**Title : HAZOP Study Of 4TACH**							**Plant Name: Plant-4, Date- 13-11-2021**			
Node 16		**Node Description : Recovered AESOL-T tank (040ST-149)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Tank bottom valve passed/leakage	spillage	not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.							
		High	Refer high Flow									
5	Composition	Other than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

APPENDIX-2: P&ID DIAGRAMS



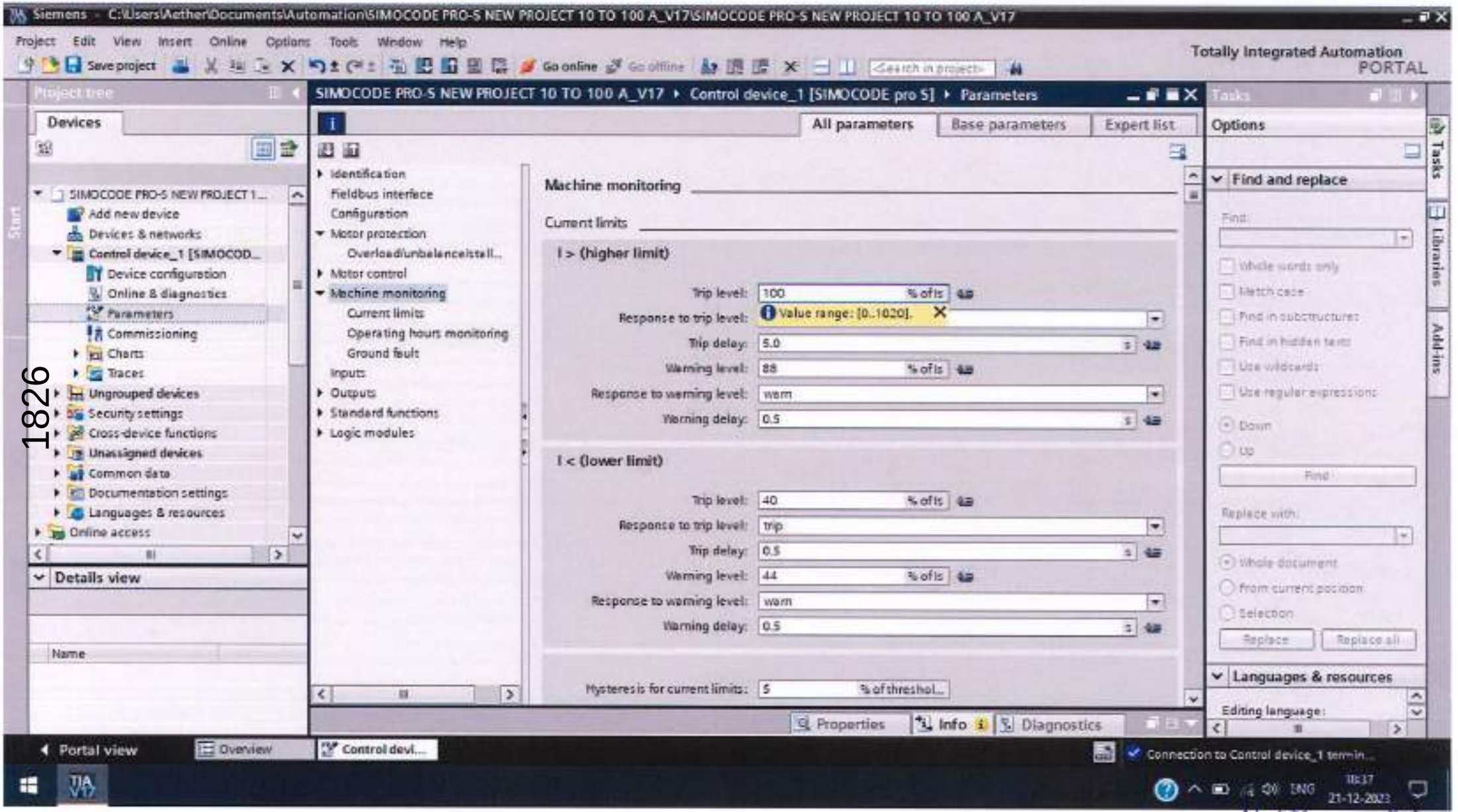


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4TACH HAZOP Recommendation Summary						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	Pure IPA storage tank(040ST-166)	Material loading and unloading in IPA storage tank	Recommend to provide overload tripping on pump.	Electrical	Completed	1
2	Autoclave(043RT-112)	Hydrogenation reaction	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	2
3		Filtration in candle filter(042CF-002)	Spill kit to be provided in the nearby area to contain spillage.	Safety	Completed	3
4	Crude Crystalizer(042RT-093)	Heating & Maintaining in crude crystalizer(042RT-093)	PM of flame arrestor is performed as per predefined schedule	Mechanical	Completed	4
5	Separation storage tank(041ST-132)	Material loading and unloading in separation storage tank	Recommend to provide double valve provision to prevent valve passing/leakage.	Mechanical	Completed	5
6	Aqueous storage tank(040ST-157)	Aqueous storage tank(040ST-157)	Vent line manual valve to be in critical locked open condition with LO tag.	Mechanical	Completed	6





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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 28/10/2021 Equipment TAG No : 042RT-093 Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	Tightning done	—	✓	Sandeep
2	Check visual condition of flame element	Found OK	—	✓	Sandeep
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleened with N_2	—	✓	Sandeep
4	Visually check Gasket condition	Checked OK	—	✓	Sandeep
Note:-					

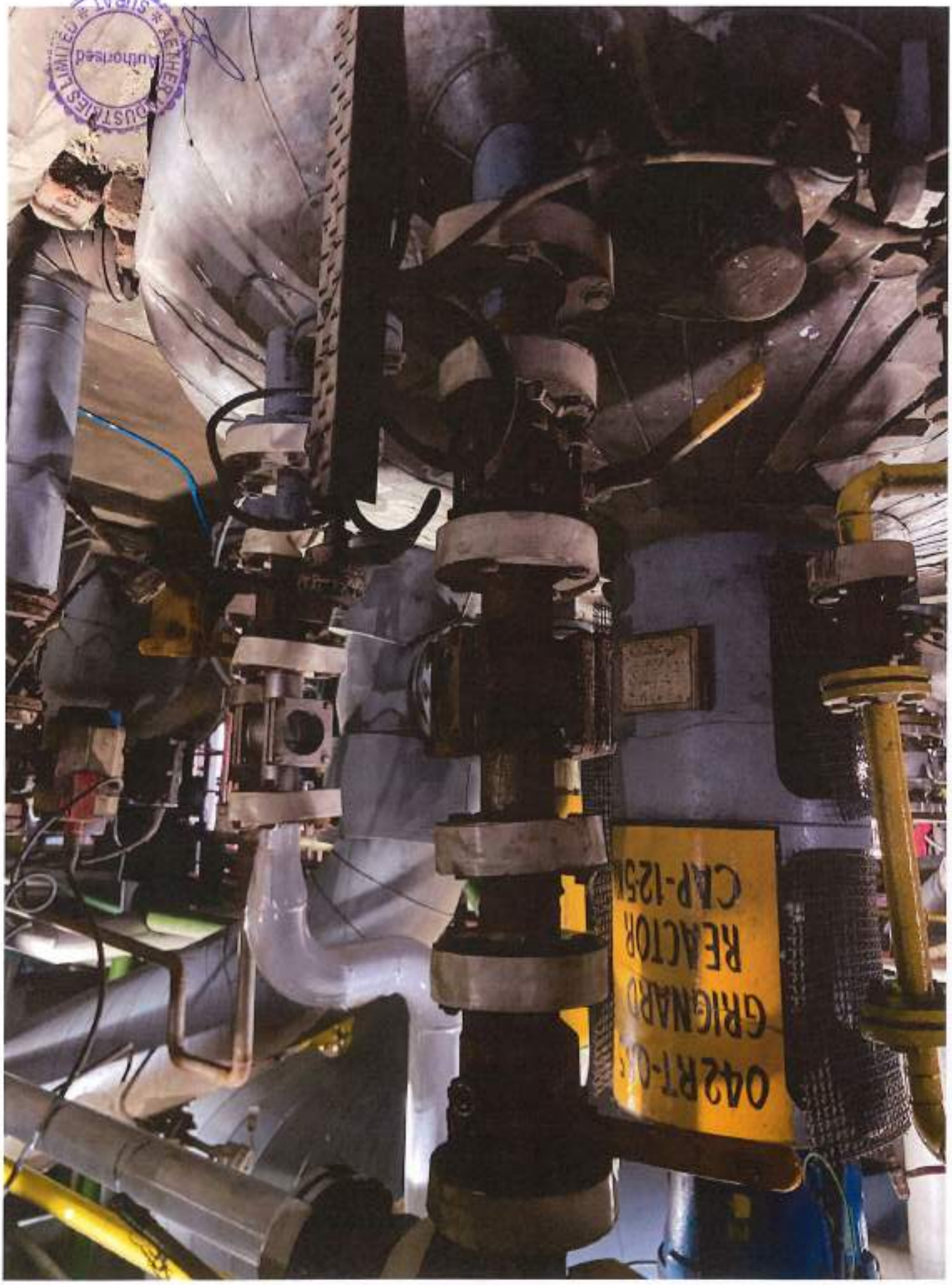
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HAZOP STUDY REPORT OF BPCP PROJECT

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

JANUARY 2022

aether
elementally innovative



NEXA
Process Safety Engineers

1833

AETHER INDUSTRIES LTD.,

SURAT

HAZOP STUDY REPORT OF

BPCP PROJECT

JANUARY 2022

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat





Proprietor

03/01/2022

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Project BPCP.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for BPCP Project.
It has 4 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	Absorption reactor (043RT-097)
2.	Quenching Reactor (042RT-098)
3.	Desorption reactor(040RT-100)
4.	BPCP Distillation (041RT-101)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process

abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

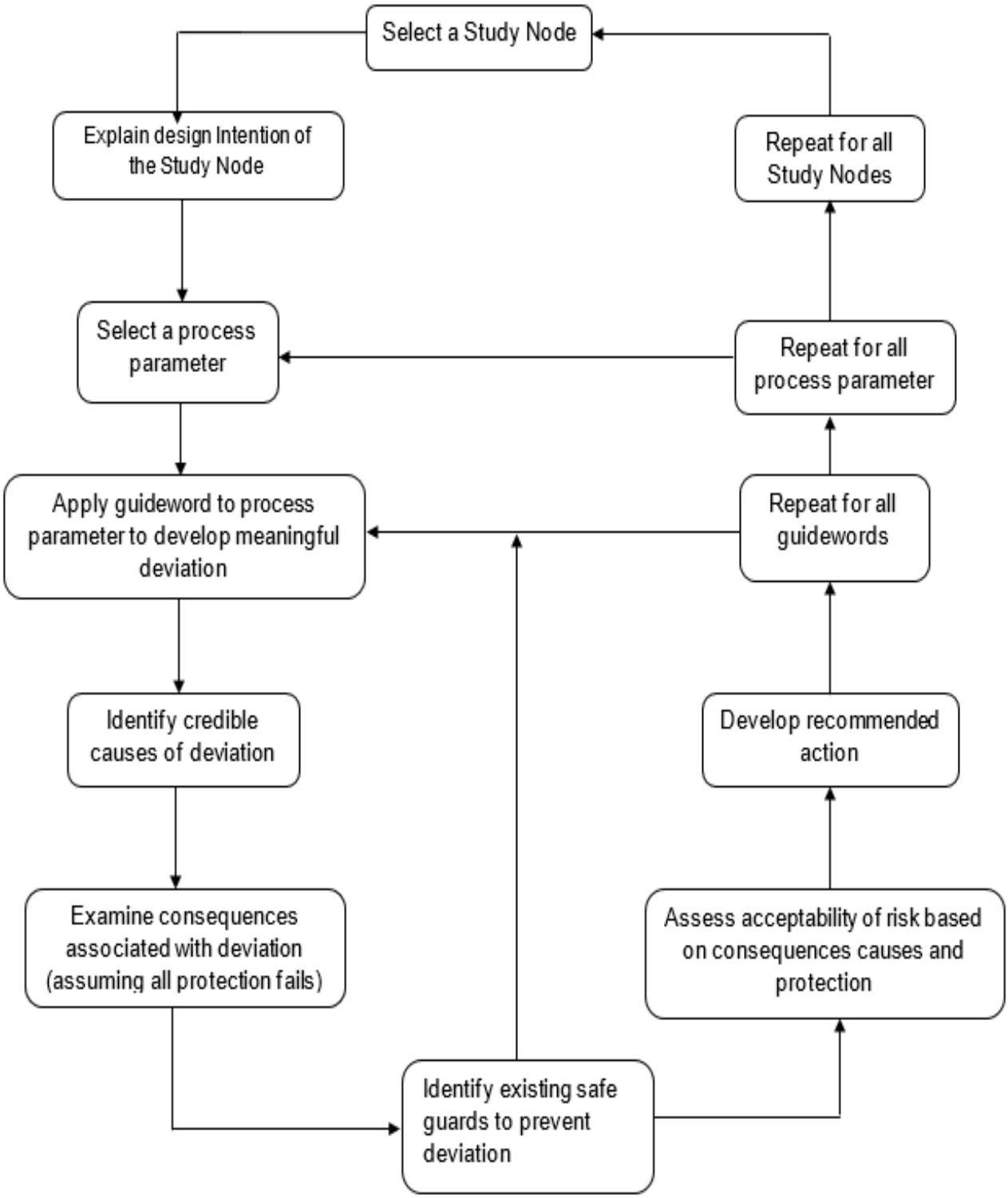
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:**But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:**Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	BPCP Plant_4

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

PlantManager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with

any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.

- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

BPCP HAZOP Recommendation Summary				
Sr. No.	**Node**	**Stream**	**Recommendations**	**Department**
1	Absorption reactor (043RT-097)	PCP charging into reactor (043RT-097)	Vent line valve should be locked open condition with locked open indication tag .	Mechanical
2		IB gas purging into reactor (043RT-097)	Recommended to provide blind in steam supply line to prevent overheating.	Mechanical
3	Quenching Reactor (042RT-098)	Reaction mass transferring in quenching reactor(042RT-098) from reactor (043RT-097)	TCV bypass valve should be locked closed condition with tagging.	Mechanical
4		20% NaOH addition in quenching reactor(042RT-098)	Vent line valve should be locked open condition with tagging.	Mechanical
5	Desorption reactor(040 RT-100)	Organic layer transferring to desorption reactor (040RT-100)	Flange guard to be provided on the flanges.	Mechanical

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please

refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08-12-2021			
Node 1		Node Description : Absorption reactor (043RT-097)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		PCP charging into reactor (043RT-097)										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Loadcell is available in tank for monitoring the level of material. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup. 5.Compatible gasket is used to prevent gasket leakage.	3	2	6				
			Human error (manual valve of reaction reactor not opened).	Line may pressurise and lead to spillage /health hazard								
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	3	3	9				
			Low level in day tank	No HSE hazard/Process Delay	1. Loadcell is available in the tank with alarms. 2.Flow meter is available in transferring line .	3	1	3				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Valve chocked	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2. Loadcell is available in tank for monitoring the level of material. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup. 5.Jacketed line is provided to prevent line chocking.	3	1	3				
		High/More	Human error (More quantity of material charged)	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating. 2. Reactor vapour line is connected with condenser or no open vent in reactor.so, no chances of overflow. 3. Loadcell is available in day tank to monitor level.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low pressure in day tank	1. Human error (Vent line valve of day tank not opened) 2. Vent line chocked	Day tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4.Day tank is design for full vacuum. 5.Jacketed vent line is provided.	3	3	9	1. Vent line valve should be locked open condition with locked open indication tag .	2	3	6
		High	Human Error (During charging reactor vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar. 5. Flash alarm is provided on HH alarm of PT of the reactor.	3	3	9				
3	Temperature	Low	No probable cause									
		High	No probable cause									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	Not applicable									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	UPS failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**MCB charging into reactor (043RT-097)**										
7	Quantity/Flow	No/Less	Human error (Bottom manual valve of tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for	3	1	3				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (manual valve of receiving line of reaction reactor not opened).	Line may pressurise and lead to fire hazard and health hazard	monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	3	3	9				
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Flange leakage	Health hazard and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Vent line valve of tank not opened)	Storage tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4. Breather valve is provided in the storage tank. 5. Interlock is provided to stop transferring pump at low low alarm of PT of storage tank.	3	3	9				
			Drain valve open/pass in storage tank	Health hazard and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification. 3.Blind is provided to all drain point open end flanges. 4.Spill kit is provided at nearby area to contain the spillage.	3	3	9				
			Human error (Circulation line valve open/pass) in storage tank	Process delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Low level in storage tank	No HSE hazard/Process Delay	1. LI is available in the day tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				
		High/More	Human error (Wrong input in flow meter)/totaliser	1. Fire hazard due to high flow in reactor. 2. Overflow from reactor	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so,overflow not possible. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification. 5.Upper limit of the totaliser to be freezed.	3	2	6				
		Reverse	Pump trip/stop	Pump mechanical failure	NRV is provide in pump discharge line to prevent back flow.	3	2	6				
		Mis-directed flow	No probable cause									
8	Pressure					3	4	12				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Low pressure in tank	Breather valve chocked	Storage tank may implode	1.Trained manpower is deputed for operation. 2.PT is available in tank with low low alarm. 3.Breather valve & Flame arrestor PM is performed before start up. 4.Interlock is provided that transferring pump to be stopped in case of low low value of PT of tank and same time transferring line XV to be closed after 20 sec of pump stop. 5. Flash alarm is provided at LL alarm value of PT.							
		High	Human Error (Charging reactor vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar. 5. Interlock is provided to stop the charging pump at HH value of PT of reactor.and	3	4	12				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					same time transferring line XV to be closed after 20 sec of pump stop. 6.Flash alarm is provide on HH alarm of PT of the reactor.							
9	Temperatur e	Low	No probable cause									
		High	No probable cause									
10	Level	Low	Refer low flow									
		High	Refer high flow									
11	Compositio n	Other than	No probable cause									
12	Others	Static Electricit y	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up. 3.J pipe is provided in reactor for charging. 4. N2 inertisation is performed during solvent charging. 5. N2 rotameter is provided in N2 supply line to ensure nitrogen inertisation. 6. Solvent charging velocity should be less than 1 m/s.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Charging line XV air fail safe position is air failed to closed condition. 4.Interlock is provided so that if XV closed in transferring line than same time transferring pump to be stop.	3	1	3				
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**PTSA charging into reactor (043RT-097)**										
13	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard		2	1	2				
		High/More	Human Error (More quantity charged)	No HSE hazard	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	2	1	2				
		Mis-directed flow	No probable cause									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
14	Pressure	Low	No probable cause									
		High	No probable cause									
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	NA									
		High	NA									
17	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed while charging in the reactor. 2. Earthing wrist band is provided to operator who will perform charging activity. 4. Double earthing is provided in the reactor. 5. Earthing continuity is ensured before start-up. 6. Suitable PPE's are available. (Goggles, Face shield, Hand gloves, Dust Mask) 7. Conductive container is used to contain powder spillage while charging into the reactor.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**IB gas purging into reactor (043RT-097)**										
18	Quantity/Flow	Low/Less	Line/Flange leakage	Fire hazard	1.Line pressure and leakage test is performed before start-up. 2. Compatible gasket is used. 3. Line MOC is MS PTFE which is compatible. 4. Fire extinguisher and fire hydrant point is available in the near by area. 5.All electrical installation are flameproof as per HAC classification.	3	3	9				
			CV pass/malfunction		1.PM of CV is performed before start-up. 2. Flow meter is also available in the line to monitor flow. 3. Stroke testing is performed for the CV periodically.	3	2	6				
		High/More	Flow meter malfunction	Temperature rise may possible	1. PM of flowmeter is performed before start-up. 2. Interlock is available to stop	3	2	6				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					addition line CV at set value of totaliser.							
			Human error (Wrong input in flow meter) totaliser		1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser and via flame arrestor. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification. 5.Upper limit of the totaliser to be freezed.	3	2	6				
			CV pass/malfunction		1.PM of CV is performed before start-up. 2. High and high high alarms are available in flowmeter. 3. Reactor vapour line is connected with condenser and via flame arrestor. 4. Interlock is available to close charging line CV at HH pressure of reactor & HH temperature of reactor. 5. PT is available in the reactor with high and high high alarms.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6. Flash alarm is provide on HH alarm of PT & HH alarm of TT of the reactor. 7. Stroke testing is performed for the CV periodically.							
		Mis-directed flow	No probable cause									
19	Pressure	Low	No probable cause									
		High	Vent line valve not opened (Human Error)	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Interlock is available to stop addition line CV at HH pressure of reactor. 3. Vent line valve is kept locked open all the time to prevent human error. 4. Reactor design pressure is 6 bar and leakage pressure test is performed before start-up.	3	3	9				
20	Temperature	Low	No probable cause									
		High	Refer high flow									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Steam TCV opened)	Temperature rise may possible	1. TI is available in the reactor with high and high high alarms. 2. CWS and CHWS available in the reactor.	3	3	9	Recommended to provide blind in steam supply line to prevent overheating.	2	3	6
21	Level	Low	No probable cause									
		High	Jacket puncture	Overflow from reactor and lead to spillage/health hazard	1. Jacket PM is performed before start-up. 2. Utility media is compatible with the reaction mass.	2	3	6				
22	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the addition line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.							
		Power Failure	GEB power failure	No HSE hazard	DG power backup is provided to the reactor.	3	1	3				
		Instrument Air Failure	Air compressor failure	No HSE hazard	1.CV of charging line air fail safe position is air fail to close. 2. Air compressor running indication is available on DCS along with the PT in supply line.	3	3	9				
		DCS Failure	GEB failure	No HSE hazard								

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 1		**Node Description : Absorption reactor (043RT-097)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Motor decoupled	Line may pressurise and lead to fire hazard and health hazard	1. Interlock is available to stop addition line CV at agitator stops.	2	3	6				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Reaction mass transferring in quenching reactor(042RT-098) from reactor (043RT-097)**										
1	Quantity/Flow	No/Less	Line leakage	Health hazard & fire hazard due to spillage	1. Line pressure test is performed before start-up. 2. Flange guard is provided in all the flanges. 3. Spill kit is available in the nearby area. 4. Fire extinguisher and fire hydrant point is provided in near by area. 5.All electrical installation as per HAC classification.	2	3	6				
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause	No HSE hazard								
		High	Human error(Manual vent line valve is not open of reactor)	Reactor may pressurise	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.Trained manpower will	3	2	6				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					operate the operation. and ensure valve position before start operation.							
3	Temperature	Low	Human error(Chilling water supply valve open)	No HSE hazard/Process Delay								
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of jacket is performed periodically.	3	3	9				
		High	Refer High/More flow									
5	Composition	Other than		No HSE hazard								
6	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure		No HSE hazard								
		Power Failure		No HSE hazard								
		DCS Failure		No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**20% NaOH addition in quenching reactor(042RT-098)**										
7	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	2	4				
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.							
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	1	3				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	No HSE hazard								
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass									
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is available to stop charging line XV at HH pressure of reactor.	3	4	12	1. Vent line valve should be locked open.	2	4	8
9	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	Not applicable									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4			**Title : HAZOP study of BPCP project at 8203 site**						**Plant Name: Plant-4, Date- 08-12-2021**			
Node 2		**Node Description : Quenching Reactor (042RT-098)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 3		**Node Description: Desorption reactor(040RT-100)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Organic layer transferring to desorption reactor (040RT-100)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Spillage may lead to health hazard & chemical exposure.	1.Line pressure test is performed before start-up. 2.Spill kit is available to contain spillage. 3.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 4.Compatible gasket is used to prevent gasket leakage.	3	2	6	Flange guard to be provided on the flanges.	2	2	4
			Human Error (Discharge Valve not opened)	No HSE hazard								
			Reactor vent valve closed	Reactor may pressurize	1.PT available in the reactor with high & high high alarms. 2.Design pressure of reactor is 6 bar and pressure test is performed before start-up.	3	3	9				
		High/More	No probable cause									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 3		**Node Description: Desorption reactor(040RT-100)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No credible cause									
		High	No credible cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the addition line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 3		**Node Description: Desorption reactor(040RT-100)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		**Solvent recovery in the desorption reactor (040RT-100)**										
6	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
7	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 3		**Node Description: Desorption reactor(040RT-100)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.							
		High Vacuum	No HSE hazard									
8	Temperature	Low	No HSE hazard									
		High	Refer low pressure									
9	Level	Low	Reactor leakage Bottom valve pass/leakage	Chemical spillage & Exposure Fire hazard	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3. All nearby electrical installations are flameproof. 4. Fire hydrant post & extinguishers are available in the nearby area. 5. Double manual valve available to prevent valve passing.	3	3	9				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 3		**Node Description: Desorption reactor(040RT-100)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
10	Composition	Other than	No probable cause									
11	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2.Vacuum breaking in system is done by nitrogen only.	3	3	9				
		Instrument Air failure	-		1.TCV in steam line and PCV of vacuum line is air failed to closed condition.							
		Power Failure	GEB power failure	-	DG is available for power backup.	3	2	6				
		DCS Failure	GEB power failure		Battery backup is available.	3	2	6				
		Agitation	Not applicable	-	1. No load tripping is provided. 2. Interlock is provided to stop steam supply line CV at agitator tripping.	3	4	12				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Crude S-1 transferring to 041ST-123**										
11	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	4	1	4				
			Line/Flange leakage	Spillage may lead to health hazard & chemical exposure.	1.Line pressure test is performed before start-up. 2.Spill kit is available to contain spillage. 3.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 4.Compatible gasket is used to prevent gasket leakage.	3	2	6				
			Human Error (Discharge Valve not opened)	Transferring line pressurization	1.Line is designed to resist maximum discharge pressure of pump to prevent line rupture. 2.PG is available in discharge line to monitor pressure. 3.Overload tripping is provided in pump. 4.Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard &	Double manual valve provided at drain point.	2	3	6				

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				chemical exposure.								
			Storage tank vent valve closed	Tank may pressurize	1.PT available in the tank with high & high high alarms.	3	3	9				
			Flame arrestor chocked	Storage tank may pressurise	1. Choking property material is not stored. 2. PT is available in the storage tank. 3. Flame arrestor PM is performed periodically.	3	3	9				
			Line chocked	No HSE hazard								
		High/More	Fixed capacity centrifugal pump is used so high flow not possible.									
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in the pump discharge line to prevent reverse flow.	3	2	6				
		Mis-directed flow	No probable cause									
12	Pressure	Low	No probable cause									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
13	Temperature	Low	No credible cause									
		High	No credible cause									
14	Level	Low	Refer low Flow									
		High	Refer high Flow									
15	Others	Static charge	-									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to	No HSE hazard/Process Delay								

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			mechanical failure									
Stream-2		**BPCP distillation in the desorption reactor (041RT-101)**										
6	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
7	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	3	9				
		High Vacuum	No HSE hazard									

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
8	Temperature	Low	No HSE hazard									
		High	Refer low pressure									
9	Level	Low	Reactor leakage Bottom valve pass/leakage	Chemical spillage & Exposure	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3. All nearby electrical installations are flameproof. 4. Double manual valve available to prevent valve passing.	3	3	9				
		High	No probable cause									
10	Composition	Other than	No probable cause									
11	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2.Vacuum breaking in system is done by nitrogen only.	3	3	9				
		Instrument Air failure	-		1.TCV in steam line and PCV of vacuum line is air failed to closed condition.							

HAZOP study of BPCP project at 8203 site												
P&ID of BPCP Plant_4		**Title : HAZOP study of BPCP project at 8203 site**							**Plant Name: Plant-4, Date- 08-12-2021**			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	-	DG is available for power backup.	3	2	6				
		DCS Failure	GEB power failure		Battery backup is available.	3	2	6				
		Agitation	Not applicable	-	1. No load tripping is provided. 2. interlock is provided to stop steam supply line CV at agitator tripping.	3	4	12				

|| END OF THE REPORT ||

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BPCP HAZOP Recommendation Summary						
Sr No	Node	Stream	Recommendations	Department	Status	Page No.
1	Absorption reactor (043RT-097)	PCP charging into reactor (043RT-097)	Vent line valve should be locked open condition with locked open indication tag .	Mechanical	Completed	1
2		IB gas purging into reactor (043RT-097)	Recommended to provide blind in steam supply line to prevent overheating.	Mechanical	Completed	2
3	Quenching Reactor (042RT-098)	Reaction mass transferring in quenching reactor(042RT-098) from reactor (043RT-097)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	3
4		20% NaOH addition in quenching reactor(042RT-098)	Vent line valve should be locked open condition with tagging.	Mechanical	Completed	4
5	Desorption reactor(040RT-100)	Organic layer transferring to desorption reactor (040RT-100)	Flange guard to be provided on the flanges.	Mechanical	Completed	5

AETHER INDUSTRIES LIMITED
Authorised
SURAT


CRITICAL VALVE
LOCKED OPEN

ETHER INDUSTRIES LIMITED * SURAT *
Authorised



Authorised
SURAT * AETHER INDUSTRIES LIMITED *




PWR LINE

1895

AETHER INDUSTRIES LIMITED * SURAT * Authorised



5

1896

HAZOP STUDY REPORT OF

4 TACH PRODUCT

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

DECEMBER 2023

aether
elementally innovative



NEXA
Process Safety Engineers

1897

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

HAZOP STUDY REPORT OF

4 TACH PRODUCT

DECEMBER 2023

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel and his team and all other Head of the departments of respective plant for speedy completion of this report.

Surat **Proprietor**

08-12-2023 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation.
- To identify significant operating or quality problems.
- To identify practical problems associated with maintenance operation.

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for 4TACH project.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management. The participants had a significant amount of experience in the Process Safety

Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally wellknown as well as the required control measures to reduce risk to acceptable levels.

During the study, Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 Scope

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for 4TACH project. It was divided in to following 16 nodes as below:

NODE NO.	NODE DESCRIPTION
1.	Pure IPA storage tank (040ST-166)
2.	Slurry reactor (043RT-111)
3.	Catalyst reactor (043RT-113)
4.	Autoclave (043RT-112)
5.	IPA recovery reactor (043RT-088)
6.	Crude Crystallizer (042RT-093)
7.	041ANFD-009
8.	Separation storage tank (041ST-132)
9.	Aqueous storage tank (040ST-157)
10.	S-2 Purification reactor (042RT-087)
11.	041ANFD-008
12.	Coupling Reactor (042RT-094)
13.	041ANFD-010
14.	ANFD ML storage tank(040ST-148)
15.	S-2 Toluene recovery reactor(043RT-096)
16.	Recovered AESOL-T tank (040ST-149)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 Methodology

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other’s ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.

5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although

it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material.

PARAMETER	TYPICAL DEVIATION	EXPLANATION
		Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50 yr	Once in 10 to 50 yr	Once in 1 to 10 yr	Once a year	More than once in a year

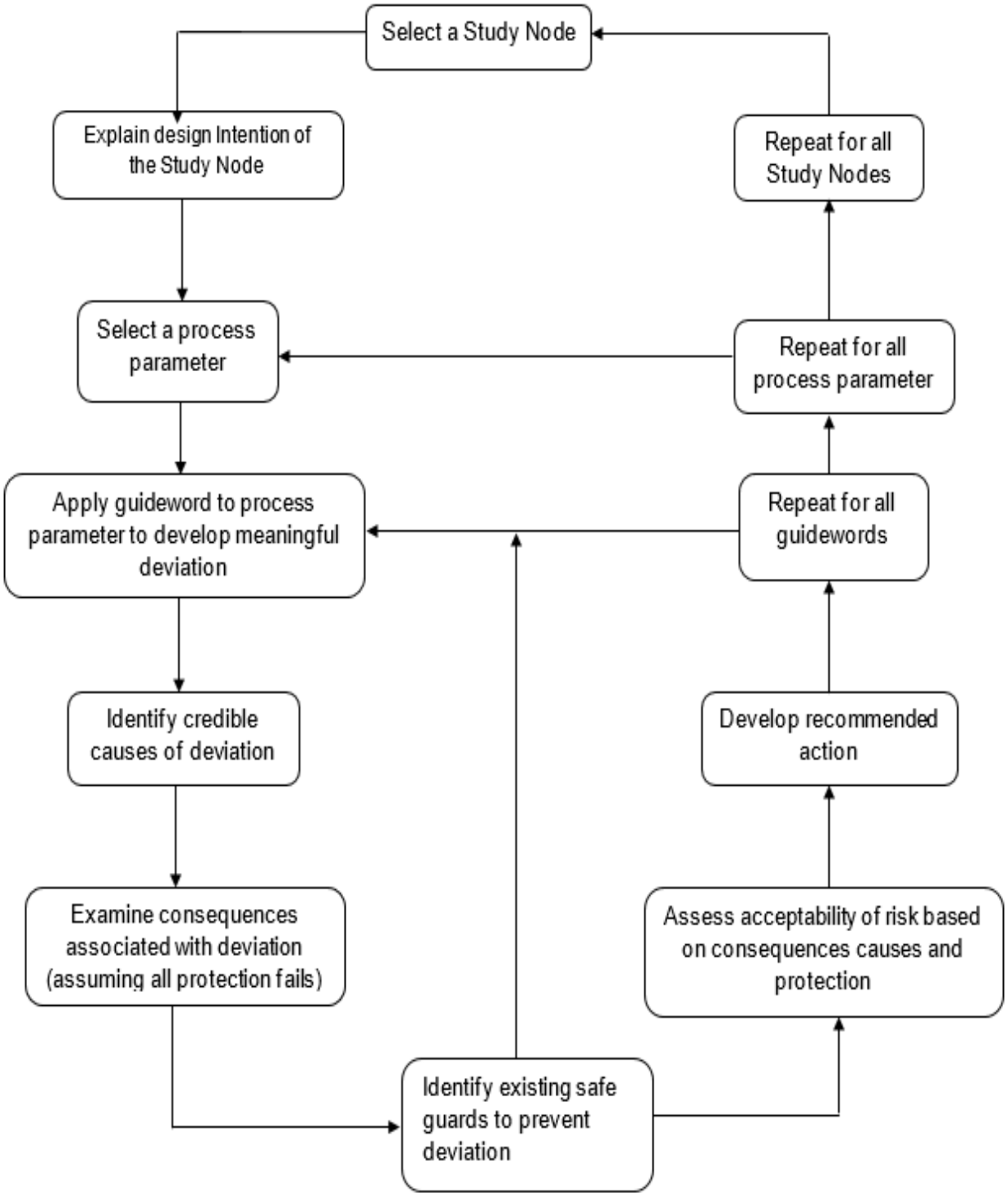
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	1- 4	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	5- 12	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	15- 25	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process) Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3 - Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2,000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4 Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg, GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work / Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of Consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition) Process safety event	Failure to meet where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact. (e.g "fuming" from drum / vent / process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5 Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	PI & D / SOPS / MSDS	8203/4TACH-STAGE-1/001 & Stage 2

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet.
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working

days of the completion of the plant HAZOP.

- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. Akhilkumar Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. Akhilkumar Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal- Electrical Mr. Smit Desai- Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team Members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION/ SPECIFIC REMARKS

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore, the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop...” Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendations are summarised as below:

Node 1		Node Description : Pure IPA storage tank(040ST-166)				
Stream-1		Material loading and unloading in IPA storage tank				
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safeguards	Recommendations
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Recommend to provide overload tripping on pump.
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1.Flame arrestor PM to be performed as per pre-defined schedule.

Node 1		Node Description : Pure IPA storage tank(040ST-166)				
Stream-1		Material loading and unloading in IPA storage tank				
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safeguards	Recommendations
			line)		2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Double mechanical seal to be provide in pump.
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	1. Recommended to provide interlock to stop transferring pump at HH alarm value of LI of storage reactor. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH alarm value of LI of storage tank. 4.Flash alarm to be provided on LS activation of storage tank.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			PVRV chocked/malfunctionin	Tank may implode	1.PT is available on tank with low and low alarm.	1.PVRV PM to be performed as per pre-defined schedule.

Node 1		Node Description : Pure IPA storage tank(040ST-166)				
Stream-1		Material loading and unloading in IPA storage tank				
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safeguards	Recommendations
			g		1.PM is carried out before start operation.	
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	1.PVRV PM to be performed as per pre-defined schedule.
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Double manual valve to be provide in N2 line.
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	1.PM to be performed of PRV as per predefined schedule.
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms	

Node 1		Node Description : Pure IPA storage tank(040ST-166)				
Stream-1		**Material loading and unloading in IPA storage tank**				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
		High	No credible cause	-	TI is available in reactor with high and high high alarms.	
4	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage		3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Double manual valve to be provide at bottom of the tank.

Node 2		Node Description : Slurry reactor(043RT-111)				
Stream-1		**IPA charging in slurry reactor(043RT-111) from IPA storage tank(040ST-166)**				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of IPA tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before start-up. 3.Compatible gasket to be used to prevent gasket leakage.
			Human error (manual valve of IPA receiving line of slurry reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard		
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before start-up. 3.Compatible gasket to be used to prevent gasket

Node 2		Node Description : Slurry reactor(043RT-111)				
Stream-1		IPA charging in slurry reactor(043RT-111) from IPA storage tank(040ST-166)				
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	Recommendations
					available in near by area. 4.All electrical installation are flameproof as per HAC classification.	leakage.
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	Blind to be provided to all drain point open end flanges.
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health & fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so, no chances of overflow.	Upper limit of the totaliser to be freezed.
2	Pressure	High	Human Error (During IPA charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor and same XV to be closed after 20 sec of pump stop. 2.Flash alarm to be provide on HH alarm of PT of the reactor.
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in the reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor. 3.Steam line to be blinded in slurry reactor.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	1. N2 inertisation to be performed during charging.

Node 2		Node Description : Slurry reactor(043RT-111)				
Stream-1		IPA charging in slurry reactor(043RT-111) from IPA storage tank(040ST-166)				
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	Recommendations
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Recommend to provide interlock that if XV closed in transferring line than same time transferring pump to be stop. 2.IPA charging line XV air failed safe position to be air failed to closed condition.

Node 4		Node Description : Autoclave(043RT-112)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Hydrogenation reaction**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
2	Pressure	Low	Leakage from the reactor	Fire hazard	1. Hydrogen detector is available to detect leakages with high and high alarms. 2. Interlock is available to stop hydrogen supply line ROV & PCV in case of H2 detector high high value. 3. Interlock is also available to stop steam TCV in case of high high value of H2 detector. 4. PT is available to monitor pressure in the reactor. 5. Pressure test is being carried out before starting batch.	1.Flash alarm to be provide on HH value of H2 detector . 2.Flash alarm to be provide on HH value of PT of the autoclave.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.
3	Temperature	High	TI malfunction	Exotherm may possible in the reactor	1.TI is provided in utility supply & return line. 2.PM is performed before start up.	1.Recommend to provide dual RTD in reaction reactor and if difference between both RTD is more than 5 degree Celsius than all interlock

Node 4		Node Description : Autoclave(043RT-112)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
						provided on primary RTD to be activated. 2.PM to be performed as per predefined schedule.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	1.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
5	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Steam supply line TCV,H2 line ROV & PCV air failed safe position is air failed to closed condition.
Stream-2		**Filtration in candle filter(042CF-002)**				
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard/Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.

Node 4		Node Description : Autoclave(043RT-112)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			No/low level in autoclave	No HSE hazard/Process Delay	No existing safeguard.	1.Recommended to manually observe the level autoclave.
7	Pressure	High	High pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line maximum pressure is maintain up-to 3 kg/cm2. 3.PT is available in candle filter with high and high alarm.	1.Flash alarm to be provide on HH value of PT of the candle filter.
9	Level	Low	Body leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1.Filter design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve to be provide to prevent valve passing.	1.Spill kit to be provided in the nearby area to contain spillage.

Node 5		Node Description : IPA recovery reactor(043RT-088)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Solvent recovery from IPA recovery reactor(043RT-088)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging	1.Recommend to provide overload tripping on pump.

Node 5		Node Description : IPA recovery reactor(043RT-088)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					activity and ensure valve operation before start-up.	
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
3	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is	1.PM of TCV is to be performed as per predefined schedule.

Node 5		Node Description : IPA recovery reactor(043RT-088)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					performed before start operation.	
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.
6	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.

Node 6		Node Description : Crude Crystalizer (042RT-093)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
Stream-1		**Heating & Maintaining in crude crystalizer(042RT-093)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 6		Node Description : Crude Crystalizer (042RT-093)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
					flameproof as per HAC classification.	
2	Pressure	High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	1.Double valve to be provided in N2 supply line.
			Human error(Manual vent valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	1.Recommend to provide interlock to closed the steam TCV at HH value of PT of the reactor.
			Flame arrestor chocked		PM of flame arrestor is performed before startup	PM of flame arrestor is performed as per predefined schedule
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of TI of the reactor.

Node 6		Node Description : Crude Crystalizer (042RT-093)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
					high high alarm.	
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor. 2.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	1.PM to be performed as per predefined schedule.
4	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	1.Spill kit to be provide to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used prevent gasket leakage.
			Reactor bottom valve passed		1.Compatible MOC of valve is used at bottom of the reactor.	1.Double manual valve to be provided at bottom of the reactor.
			Reactor Leakage		Reactor MOC is compatible with material.	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.
6	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.

Node 7		Node Description : 041ANFD-009				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Filtration & Drying in 041ANFD-009**				
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the ANFD	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the ANFD with high and high high alarms. 5. TI is available in the ANFD with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the ANFD. 4. Flash alarm to be provided at HH temperature and HH pressure of the ANFD.
		High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in ANFD with high and high high alarm.	1.Flash alarm to be provide on HH value of PT of the ANFD.
3	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the ANFD with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the ANFD. 4. Flash alarm to be provided at HH temperature of the ANFD.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is	1.PM of TCV is to be performed as per predefined schedule.

Node 7		Node Description : 041ANFD-009				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					available on DCS with percentage. 5.PM of TCV is performed before start operation.	
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
5	Others	Instrument Air failure	Air compressor failure	ANFD may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum line air failed safe position is air failed to closed condition. 3.ROV of vacuum line air failed safe position is air failed to open condition.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.

Node 8		Node Description : Separation storage tank (041ST-132)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Material loading and unloading in separation storage tank**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower	1.Recommend to provide overload tripping on pump.

Node 8		Node Description : Separation storage tank (041ST-132)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					will perform charging activity and ensure valve operation before start-up.	
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT of the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Double mechanical seal to be provide in pump.
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	1. Recommended to provide interlock to stop transferring pump at LS activation. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on LS activation of storage tank.
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical	1. Recommended to provide interlock to stop transferring pump at HH value of LI of the storage

Node 8		Node Description : Separation storage tank (041ST-132)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					instrument is performed before startup.	tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH value of LI of the storage tank.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	1.PVRV PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on	1.Flame arrestor PM to be performed as per pre-defined schedule.

Node 8		Node Description : Separation storage tank (041ST-132)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					tank.	
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	1.PVRV PM to be performed as per pre-defined schedule.
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Double manual valve to be provide in N2 line.
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	1.PM to be performed of PRV as per predefined schedule.
4	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage		3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Double manual valve to be provide at bottom of the tank.

Node 9		Node Description : Aqueous storage tank(040ST-157)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Aqueous storage tank(040ST-157)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 9		Node Description : Aqueous storage tank(040ST-157)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1.Flame arrestor PM to be performed as per pre-defined schedule.
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	1. Recommended to provide interlock to stop transferring pump at LS activation. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on LS activation of storage tank.
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	1. Recommended to provide interlock to stop transferring pump at HH value of LI of the storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH value of LI of the storage tank.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.

Node 9		Node Description : Aqueous storage tank(040ST-157)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1.Flame arrestor PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	PM of flame arrestor is performed before start-up.	1.Flame arrestor PM to be performed as per pre-defined schedule.
4	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage		1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Double manual valve to be provide at bottom of the tank.

Node 10		Node Description : S-2 Purification reactor(042RT-087)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Toluene charging in S-2 purification reactor(042RT-087) from storage tank**				
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of toluene tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed

Node 10		Node Description : S-2 Purification reactor(042RT-087)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Human error (manual valve of toluene receiving line of S-2 purification reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before start-up.	before start-up. 3.Compatible gasket to be used to prevent gasket leakage.
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	Blind to be provided to all drain point open end flanges.
		High/More	Human error (Wrong input in flow meter/totaliser)	Overflow from reactor and lead to spillage/health& fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser .so, no chances of overflow.	Upper limit of the totaliser to be freezed.
2	Pressure	High	Human Error (During toluene charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor and same XV to be closed after 20 sec of pump stop. 2.Flash alarm to be provide on HH alarm of PT of the reactor.
			Flame arrestor		PM of flame arrestor	PM of flame arrestor is

Node 10		Node Description : S-2 Purification reactor(042RT-087)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			chocked		is performed before start-up.	performed as per predefine schedule.
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in the reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	1. N2 inertisation to be performed during charging.
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Recommend to provide interlock that if XV closed in transferring line than same time transferring pump to be stop. 2.Toluene charging line XV air failed safe position to be air failed to closed condition.
Stream-3		**Heating & reflux in S-2 purification reactor(042RT-087)**				
13	Pressure	High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.

Node 10		Node Description : S-2 Purification reactor(042RT-087)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	1.Double valve to be provided in N2 supply line.
			Human error(Manual vent valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	1.Recommend to provide interlock to closed the steam TCV at HH value of PT of the reactor.
			Flame arrestor chocked		PM of flame arrestor is performed before startup	PM of flame arrestor is performed asper predefine schedule
14	Temperature	High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of TI of the reactor.
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor. 2.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	1.PM to be performed as per predefined schedule.

Node 10		Node Description : S-2 Purification reactor(042RT-087)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
15	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	1.Spill kit to be provide to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used prevent gasket leakage.
			Reactor bottom valve passed		1.Compatible MOC of valve is used at bottom of the reactor.	1.Double manual valve to be provided at bottom of the reactor.
			Reactor Leakage		Reactor MOC is compatible with material.	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.
17	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.

Node 11		Node Description : 041ANFD-008				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Hot Filtration in ANFD(041ANFD-008)**				
2	Pressure	High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in ANFD ensure before startup that valve is	1.Flash alarm to be provide on HH value of PT of the ANFD.

Node 11		Node Description : 041ANFD-008				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					open condition. 5.PT is available in ANFD with high and high high alarm.	
3	Temperature	High	Human error(Steam line valve open/passes)	Exotherm may possible in ANFD	1.TI is available in ANFD with high and high alarm. 2.Trained manpower is deputed for operation. 3.Double valve is available in steam line.	1.Blind to be provide in steam line to avoid human error/over heating. 2.Flash alarm to be provide on HH value of TI of ANFD.

Node 12		Node Description : Coupling Reactor(042RT-094)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
Stream-1		**Crystallization in coupling reactor(042RT-094)**				
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of sparkler filter is not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flange guard is provided in transferring line. 3.Line pressure test is performed before start up.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before start up. 3.Compatible gasket to be used to prevent gasket leakage.
			Human error (manual valve of ML receiving line on coupling reactor is not opened).			
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before start up. 3.Compatible gasket to be used to prevent gasket leakage.
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	Blind to be provided to all drain point open end flanges.
2	Pressure	High	Human Error (Vent line/vapour line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms.	1. Interlock to be provided to stop the ml transferring pump from sparkler filter at HH value of PT of

Node 12		Node Description : Coupling Reactor(042RT-094)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
					2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	reactor 2.Flash alarm to be provide on HH alarm of PT of the reactor.
			Flame arrestor chocked		PM of flame arrestor is performed before start up.	PM of flame arrestor is performed as per predefined schedule.
3	Temperature	High	Human error(steam line manual valve open passed)	Temperature rise may possible in the reactor	1.TI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation.	1.Steam line to be blinded to avoid human error. 2.Flash alarm to be provide on HH value of RTD of the reactor.
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	1. N2 inertisation to be performed during charging.
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Chilling water supply line ROV air failed safe position is air failed to open condition.

Node 13		Node Description : 041ANFD-010				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Filtration & Drying in 041ANFD-010**				
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the ANFD	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the ANFD with high and high high alarms. 5. TI is available in the ANFD with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the ANFD. 4. Flash alarm to be provided at HH temperature and HH pressure of the ANFD.

Node 13		Node Description : 041ANFD-010				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in ANFD with high and high high alarm.	1.Flash alarm to be provide on HH value of PT of the ANFD.
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.ANFD design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	
3	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the ANFD with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the ANFD. 4. Flash alarm to be provided at HH temperature of the ANFD.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before	1.PM of TCV is to be performed as per predefined schedule.

Node 13		Node Description : 041ANFD-010				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					start operation.	
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
5	Others	Instrument Air failure	Air compressor failure	ANFD may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum line air failed safe position is air failed to closed condition. 3.ROV of vacuum line air failed safe position is air failed to open condition.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.

Node 14		Node Description : ANFD ML storage tank(040ST-148)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
Stream-1		**Material loading and unloading in ANFD ML storage tank**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT of the tank.

Node 14		Node Description : ANFD ML storage tank(040ST-148)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	1.Flame arrestor PM to be performed as per pre-defined schedule.
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before start-up.	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on LS activation of storage tank.
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before start-up.	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on HH value of LI of the storage tank.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	1.Flame arrestor PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank.

Node 14		Node Description : ANFD ML storage tank(040ST-148)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safeguards**	**Recommendations**
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.Local vent is provided in storage tank.	1.Double manual valve to be provide in N2 line.
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.Local vent is provided in storage tank.	1.PM to be performed of PRV as per predefined schedule.
4	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.

Node 15		Node Description : S-2 Toluene recovery reactor(043RT-096)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream -1		**S-2 Toluene recovery reactor(043RT-096)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 15		Node Description : S-2 Toluene recovery reactor(043RT-096)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Recommend to provide overload tripping on pump.
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
3	Temperatur e	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum

Node 15		Node Description : S-2 Toluene recovery reactor(043RT-096)				
Sr. No	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					4. Compound PT is available on the reactor. 5. TI is available in the reactor with high and high high alarms.	pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	1.PM of TCV is to be performed as per predefined schedule.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.
6	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.

Node 16		Node Description : Recovered AESOL-T tank (040ST-149)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Material loading and unloading in AESOL-T storage tank**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human Error (Discharge Valve not opened)			
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT of the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on LS activation of storage tank.
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on HH value of LI of the storage tank.

Node 16		Node Description : Recovered AESOL-T tank (040ST-149)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	1.PVRV PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.

Node 16		Node Description : Recovered AESOL-T tank (040ST-149)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	1.PVRV PM to be performed as per pre-defined schedule.
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Double manual valve to be provide in N2 line.
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	1.PM to be performed of PRV as per predefined schedule.
4	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed, and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved

operability and maintainability" categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please refer to column entitled "Action Tracking" in the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for **M/s Aether Industries Ltd., Surat**. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with **M/s Aether Industries Ltd., Surat**.

APPENDIX-1: HAZOP MINUTES

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 1		**Node Description : Pure IPA storage tank(040ST-166)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in IPA storage tank**										
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.Flow meter is available in material transferring line . 3.LI is available in storage tank to motor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Pure IPA storage tank(040ST-166)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3.Trained manpower will perform charging activity and ensure valve operation before start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023		
Node 1		Node Description : Pure IPA storage tank(040ST-166)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double mechanical seal to be provide in pump.	2	3	6
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	3	3	9	1. Recommended to provide interlock to stop transferring pump at HH alarm value of LI of storage reactor. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH alarm value of LI of storage tank. 4.Flash alarm to be provided on LS	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023		
Node 1		Node Description : Pure IPA storage tank(040ST-166)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									activation of storage tank.			
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023		
Node 1		Node Description : Pure IPA storage tank(040ST-166)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3.PVRV is available in tank.							
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Pure IPA storage tank(040ST-166)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Double manual valve to be provide in N2 line.	2	4	8
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023		
Node 1		Node Description : Pure IPA storage tank(040ST-166)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tank bottom valve passed/leakage		3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									
5	Composition	Other than	Wrong material supplied from vendor	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before tanker unloading start.	2	3	6				
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		IPA charging in slurry reactor(043RT-111) from IPA storage tank(040ST-166)										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of IPA tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before start-up.	3	1	3	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.			
			Human error (manual valve of IPA receiving line of slurry reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard								
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	3	3	9	Blind to be provided to all drain point open end flanges.	2	3	6
			Human error (Circulation line valve open/pass) in storage tank	Process delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				0
			Low level in storage tank	No HSE hazard/Process Delay	1. LI is available in the tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				0
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health& fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so, no chances of	3	3	9	Upper limit of the totaliser to be freezed.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					overflow.							
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human Error (During IPA charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor.And same XV to be closed after 20 sec of pump stop. 2.Flash alarm to be provide on HH alarm of PT of the reactor.	2	4	8
3	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in the reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor. 3.Steam line to be blinded in slurry reactor.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4.RTD is available in reactor with high and high high alarm.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	3	3	9	1. N2 inertisation to be performed during charging.	2	3	6
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	2	6	1.Recommend to provide interlock that if XV closed in transferring line than same time transferring pump to be stop. 2.IPA charging line XV air failed safe position	3	2	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									to be air failed to closed condition.			
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		Powder charging in slurry reactor(043RT-111)										
7	Quantity/Flow	No/Less	Human error (Less quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		High/More	Human error (More quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			No probable cause									
9	Temperature	Low	No credible cause									
		High	No credible cause									
10	Level	Low	Refer low Flow									
		High	Refer high Flow									
11	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor . 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Leakage spillage		No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 2		Node Description : Slurry reactor(043RT-111)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 3		Node Description : Catalyst reactor(043RT-113)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Catalyst charging in catalyst reactor(043RT-113)										
1	Quantity/Flow	No/Less	Human error (Less quantity of Catalyst charged)	No HSE hazard/Process delay	1.Batch wise fix charging quantity of catalyst will be issued from the store to prevent human error. 2.Loadcell is available on catalyst reactor.	3	2	6				
		High/More	Human error (More quantity of Catalyst charged)	No HSE hazard/Process delay	1.Batch wise fix charging quantity of catalyst will be issued from the store to prevent human error. 2.Loadcell is available on catalyst reactor.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	No probable cause									
			No probable cause									
3	Temperature	Low	No credible cause									
		High	Refer high									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 3		Node Description : Catalyst reactor(043RT-113)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flow									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the tank.	3	3	9				
		Leakage spillage		Fire hazard	1.Trained manpower will perform the catalyst charging activity. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 3		Node Description : Catalyst reactor(043RT-113)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Hydrogenation reaction										
1	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard								
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
		High/More	High pressure of N2 in N2	No HSE hazard								

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			line									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	Leakage from the reactor	Fire hazard	1. Hydrogen detector is available to detect leakages with high and high alarms. 2. Interlock is available to stop hydrogen supply line ROV & PCV in case of H2 detector high high value. 3. Interlock is also available to stop steam TCV in case of high high value of H2 detector. 4. PT is available to monitor pressure in the reactor. 5. Pressure test is being carried out before starting batch.	3	3	9	1.Flash alarm to be provide on HH value of H2 detector . 2.Flash alarm to be provide on HH value of PT of the autoclave.	2	3	6
		High	Hydrogen supply pressure high	Reactor may pressurize	1. H2 PRS system available to supply required pressure. 2. PCV available to supply H2 pressure in reactor.	3	4	12				0

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3. ROV is available in the H2 supply line. 4. PT is available in the reactor with high and high high alarm. 5. Interlock is available to stop ROV and PCV in case of high high pressure of reactor. 6. PT is available in the H2 supply line with high and high high alarms. 7. Interlock is also available to stop ROV and PCV of H2 supply line on high high value of H2 supply line PT. 8. RD and PSV is available on reactor with discharge is connected with dump tank. 9. ROV is available in separate vent line on reactor connected with dump tank.and open at HH pressure of the reactor. 10. Nitrogen inertisation is provided in the dump tank.							
			TCV failure/stuck		1.PM is performed of TCV before start up.	3	4	12	1.PM of TCV to be carried out as per	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			open		2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.				predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.			
3	Temperature	Low	Human Error (Cooling started instead of heating)	No HSE hazard.		0	0	0		0	0	0
		High	H2 supply pressure high	Exotherm may possible in the reactor	1. TT is available in the reactor with high and high high alarms. 2. Interlock is available to close TCV of steam supply line on high high value of TI of the reactor. 3. TI also available in steam supply line with high and high high alarms. 4. Interlock is available to close steam supply line TCV in case of supply line TT temperature high high value. 5.Interlock is available to	3	4	12		0	0	0

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023

Node 4	Node Description : Autoclave(043RT-112)

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					close the steam supply line TCV at HH value of PT of H2 supply line.							
			TI malfunction		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	3	4	12	1.Recommend to provide dual RTD in reaction reactor.and if difference between both RTD is more than 5degree celcius than all interlock provided on primary RTD to be activated. 2.PM to be performed as per predefined schedule.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023		
Node 4		Node Description : Autoclave(043RT-112)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12	1.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	Refer low Flow			0	0	0		0	0	0
		High	Refer low Flow			0	0	0		0	0	0
			Jacket puncture of the reactor	Reactor may overflow and chances of spillage/leakage	Before startup spark test & thickness testing is performed.	3	3	9				
			Tube bundle leakage in reactor		PM of tube bundle is performed before startup.	3	3	9				
5	Others	Static charge	Venting rate high during H2 venting	Fire hazard	1. CV is available in the vent line to maintain venting rate 0.5 bar/min. 2. N2 flushing is also done while H2 venting. 3. Flowmeter is available in the N2 line to ensure nitrogen flow during venting.	4	3	12				0

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					4. Low and low low alarm available with N2 flowmeter. 5. Interlock is available to stop CV of H2 venting line in case of nitrogen supply flowmeter low low value. 6. Steam snuffing is available at the end of the vent line with sprager. 7. Endurance burning RTD with flame arrestor is available in the vent line. 8. Catch pot is available with water for venting of hydrogen.							
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Steam supply line TCV,H2 line ROV & PCV air failed safe position is air failed to closed condition.	2	1	2
		Power failure	GEB power failure	Runaway may possible	DG backup is provided to all critical equipments.	3	3	9				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 4		**Node Description : Autoclave(043RT-112)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Decoupling	Runaway may possible	1. No load tripping available in case agitator decoupling. 2. Interlock is available to stop H2 supply line ROV, PCV and steam supply line TCV in case of agitator decoupling.	3	3	9				
Stream -2		**Filtration in candle filter(042CF-002)**									
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard/Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of autoclave to filter transferring line is closed)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023

Node 4	Node Description : Autoclave(043RT-112)

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			No/low level in autoclave	No HSE hazard/Process Delay	No existing safeguard.	3	1	3	1.Recommended to manually observe the level autoclave.	2	1	2
			Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line pressure is maintain 3 kg/cm2.	3	1	3				
		High/More	High pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line maximum pressure is maintain up-to 3 kg/cm2.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
7	Pressure	Low	Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line pressure is maintain 3 kg/cm2. 3.PT is available in candle filter with low and low low alarm.	3	1	3				
		High	High pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank. 2.N2 line maximum pressure is maintain up-to 3 kg/cm2. 3.PT is available in candle	3	1	3	1.Flash alarm to be provide on HH value of PT of the candle filter.			

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					filter with high and high alarm.							
8	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
9	Level	Low	Body leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1.Filter design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve to be provide to prevent valve passing.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High	Jacket puncture of the filter	Overflow may possible from filter and lead to fire&health hazard	1.Fire hydrant point & extinguisher is available in near by area. 2.All electrical installation are flameproof as per HAC classification. 3.Thickness testing to be performed before startup.	3	3	9				
10	Composition	Other than	No probable cause									
11	Others	Static	No probable									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 4		Node Description : Autoclave(043RT-112)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Electricity	cause									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 5		Node Description : IPA recovery reactor(043RT-088)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream -1		Solvent recovery from IPA recovery reactor(043RT-088)										
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 5		Node Description : IPA recovery reactor(043RT-088)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 5		Node Description : IPA recovery reactor(043RT-088)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.			
		High Vacuum	No probable cause	No HSE hazard								
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 5		Node Description : IPA recovery reactor(043RT-088)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									4. Flash alarm to be provided at HH temperature of the reactor.			
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	12				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC	3	3	9	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 5		Node Description : IPA recovery reactor(043RT-088)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					classification.				spillage.			
		High	Jacket puncture of the reactor	Reactor may overflow and chances of spillage/leakage	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transferring line	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise &Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.	2	4	8
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 5		Node Description : IPA recovery reactor(043RT-088)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 6		Node Description : Crude Crystallizer(042RT-093)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Heating & Maintaining in crude crystallizer(042RT-093)										
1	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard		3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay		3	1	3				
		High/More	High pressure of N2 in N2 line	No HSE hazard								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause	-	-				-			

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 6		Node Description : Crude Crystallizer(042RT-093)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12	1.Double valve to be provided in N2 supply line.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 6		Node Description : Crude Crystallizer(042RT-093)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Manual vent valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	3	4	12	1.Recommend to provide interlock to closed the steam TCV at HH value of PT of the reactor.	2	4	8
			Flame arrestor chocked		PM of flame arrestor is performed before startup	3	4	12	PM of flame arrestor is performed as per predefined schedule	2	4	8
3	Temperature	Low	Human error(Brine supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of TI of the reactor.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 6		Node Description : Crude Crystallizer(042RT-093)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor. 2.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	3	4	12	1.PM to be performed as per predefined schedule.	2	4	8
4	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9	1.Spill kit to be provide to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used prevent gasket leakage.	2	3	6
			Reactor bottom valve passed		1.Compatible MOC of valve is used at bottom of the reactor.	3	3	9	1.Double manual valve to be provided at bottom of the reactor.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 6		Node Description : Crude Crystallizer(042RT-093)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Reactor Leakage		Reactor MOC is compatible with material.	3	3	9	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.	2	3	6
		High	Jacket puncture of the reactor & condenser leakage	Reactor may overflow and material incompatible hazard may possible	1.MOC is compatible with material. 2.PG is available in utility return line. 3.No incompatible hazard with reaction mass& utility in case of jacket puncture.	3	3	9				
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transferring line	3	3	9				
		Instrume nt Air failure	Air compressor failure	Reactor may pressurise &Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close.	2	4	8
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 6		Node Description : Crude Crystallizer(042RT-093)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 7		Node Description : 041ANFD-009									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Filtration & Drying in 041ANFD-009										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	Nitrogen supply line valve pass	1.Ml transferring line may pressurise and leakage 2.Fire hazard due to spillage	1.Trained manpower will operate. 2.PT is available in ANFD with high and high high alarms. 3.Line pressure testing is being performed before start-up. 4.PRV is also available in N2 supply line. 5.N2 supply maximum pressure is upto 3 bar. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 7		Node Description : 041ANFD-009									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the ANFD	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the ANFD with high and high high alarms. 5. TI is available in the ANFD with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the ANFD. 4. Flash alarm to be provided at HH temperature and HH pressure of the ANFD.	2	4	8
		High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in ANFD	3	4	12	1.Flash alarm to be provide on HH value of PT of the ANFD.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 7		Node Description : 041ANFD-009										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with high and high high alarm.							
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.ANFD design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard		3	1	3				
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the ANFD with high and high	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 7		Node Description : 041ANFD-009										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					high alarms.				trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the ANFD. 4. Flash alarm to be provided at HH temperature of the ANFD.			
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 7		Node Description : 041ANFD-009										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
4	Level	Low	ANFD leakage, Ml transferring line valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. ANFD design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the ANFD. 2. Double earthing/grounding is provided to the ANFD. 3. Antistatic scrapper is used for unloading,	3	3	9				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 7		Node Description : 041ANFD-009									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Leakage spillage	Human error	Fire hazard Health Hazard	1.Line testing is performed before start-up. 2.Spill kit is available in the plant to 3.contain spillage in case of leakage. 4.Cartridge mask & PVC suit is used while filling powder.	3	3	9				
		Instrument Air failure	Air compressor failure	ANFD may pressurise &Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum line air failed safe position is air failed to closed condition. 3.ROV of vacuum line air failed safe position is air failed to open condition.	2	4	8
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 8		Node Description : Separation storage tank(041ST-132)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Material loading and unloading in separation storage tank									
1	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.LI is available in storage tank to motor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 8		Node Description : Separation storage tank(041ST-132)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3.Trained manpower will perform charging activity and ensure valve operation before start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT of the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 8		Node Description : Separation storage tank(041ST-132)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double mechanical seal to be provide in pump.	2	4	8
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9	1. Recommended to provide interlock to stop transferring pump at LS activation. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on LS activation of storage tank.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023
Node 8	Node Description : Separation storage tank(041ST-132)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9	1. Recommended to provide interlock to stop transferring pump at HH value of LI of the storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH value of LI of the storage tank.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 8		Node Description : Separation storage tank(041ST-132)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									the storage tank.			
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023
Node 8	Node Description : Separation storage tank(041ST-132)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Double manual valve to be provide in N2 line.	2	4	8
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 8		Node Description : Separation storage tank(041ST-132)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage		3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									
5	Composition	Other than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 8		**Node Description : Separation storage tank(041ST-132)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 9		**Node Description : Aqueous storage tank(040ST-157)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Aqueous storage tank(040ST-157)**									
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not	No HSE hazard	1.Trained manpower will perform charging activity and ensure valve operation	3	3	9				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 9		Node Description : Aqueous storage tank(040ST-157)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			opened)		before start-up.							
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9	1. Recommended to provide interlock to stop transferring pump at LS activation. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on LS	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 9		Node Description : Aqueous storage tank(040ST-157)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									activation of storage tank.			
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9	1. Recommended to provide interlock to stop transferring pump at HH value of LI of the storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH value of LI of the storage tank.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	Wrong line up(Manual valve or pump start of organic tank instead of aqueous tank line up)	No HSE hazard					-			

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 9		Node Description : Aqueous storage tank(040ST-157)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	PM of flame arrestor is performed before startup.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in tank with low and low low alarms							
		High	No credible cause	-	TI is available in tank with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023

Node 9	Node Description : Aqueous storage tank(040ST-157)

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tank bottom valve passed/leakage		1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									
6	Others	Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023

Node 10		Node Description : S-2 Purification reactor(042RT-087)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Toluene charging in S-2 purification reactor(042RT-087) from storage tank**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of toluene tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	3	1	3	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.			
			Human error (manual valve of toluene receiving line of S-2 purification reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard								
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	3	3	9	Blind to be provided to all drain point open end flanges.	2	3	6
			Human error (Circulation line valve open/pass) in storage tank	Process delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				0
			Low level in storage tank	No HSE hazard/Process Delay	1. LI is available in the tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				0
		High/More	Human error (Wrong input in flow meter/totaliser)	Overflow from reactor and lead to spillage /health& fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser .so, no chances of overflow.	3	3	9	Upper limit of the totaliser to be freezed.	2	3	6
		Reverse	Pump trip/stop	Pump mechanical failure	1.NRV is provided in pump discharge line.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human Error (During toluene charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor.And same XV to be closed after 20 sec of pump stop. 2.Flash alarm to be provide on HH alarm of PT of the reactor.	2	4	8
			Flame arrestor chocked		PM of flame arrestor is performed before startup.	3	4	12	PM of flame arrestor is performed as per predefine schedule.	2	4	8
3	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in the reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
			Human error(TCV		No existing safeguard	3	4	12	1.TCV bypass valve should be locked	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			bypass line passed/open)						closed condition with tagging.			
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	3	3	9	1. N2 inertisation to be performed during charging.	2	3	6
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	2	6	1.Recommend to provide interlock that if XV closed in transferring line than same time transferring pump to be stop. 2.Toluene charging line XV air failed safe position to be air failed to closed condition.	3	2	6
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical	No HSE hazard								

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			failure									
Stream-2		**S-1 powder charging in S-2 purification reactor(042RT-087)**										
7	Quantity/Flow	No/Less	Human error (Less quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		High/More	Human error (More quantity of Mg charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of powder will be issued from the store to prevent human error.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
			No probable cause									
9	Temperature	Low	No credible cause									
		High	No credible cause									
10	Level	Low	Refer low Flow									
		High	Refer high Flow									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 10		**Node Description : S-2 Purification reactor(042RT-087)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
11	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor . 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9				
		Leakage spillage		No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-3		**Heating & reflux in S-2 purification reactor(042RT-087)**										

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
12	Quantity/Flow	No/Less	Refer low flow of stream 1&2			3	1	3				
		High/More	Refer high flow of stream 1&2									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
13	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before start up that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12	1.Double valve to be provided in N2 supply line.	2	4	8
			Human error(Manual vent valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	3	4	12	1.Recommend to provide interlock to closed the steam TCV at HH value of PT of the reactor.	2	4	8
			Flame arrestor chocked		PM of flame arrestor is performed before startup	3	4	12	PM of flame arrestor is performed asper predefine schedule	2	4	8
14	Temperature	Low	Human error(Cooling water supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of TI of the reactor.	2	4	8
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor. 2.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM is performed before start up.	3	4	12	1.PM to be performed as per predefined schedule.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
15	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9	1.Spill kit to be provide to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used prevent gasket leakage.	2	3	6
			Reactor bottom valve passed		1.Compatible MOC of valve is used at bottom of the reactor.	3	3	9	1.Double manual valve to be provided at bottom of the reactor.	2	3	6
			Reactor Leakage		Reactor MOC is compatible with material.	3	3	9	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.	2	3	6
		High	Jacket puncture of the reactor & condenser leakage	Reactor may overflow and material incompatible hazard may possible	1.MOC is compatible with material. 2.PG is available in utility return line. 3.No incompatible hazard with reaction mass& utility in case of jacket puncture.	3	3	9				
16	Composition	Other than	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 10		Node Description : S-2 Purification reactor(042RT-087)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transfering line	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close.	2	4	8
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 11		Node Description : 041ANFD-008									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Hot Filtration in ANFD(041ANFD-008)										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	Nitrogen supply line valve pass	1.Ml transferring line may pressurise and leakage 2.Fire hazard due to spillage	1.Trained manpower will operate. 2.PT is available in ANFD with high and high high alarms. 3.Line pressure testing is being performed before start-up. 4.PRV is also available in N2 supply line. 5.N2 supply maximum pressure is up to 3 bar. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 11		Node Description : 041ANFD-008									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error (Vent line/vapour line valve not opened)	ANFD may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in ANFD with high and high high alarm. 3.ANFD design pressure is up to 6 bar. 4.Interlock is provided to closed the steam TCV at HH value of PT of the ANFD.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in ANFD ensure before startup that valve is open condition. 5.PT is available in ANFD with high and high high alarm.	3	4	12	1.Flash alarm to be provide on HH value of PT of the ANFD.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 11		Node Description : 041ANFD-008									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard		2	2	4				
		High	Human error(Steam line valve open/passes)	Exotherm may possible in ANFD	1.TI is available in ANFD with high and high alarm. 2.Trained manpower is deputed for operation. 3.Double valve is available in steam line.	3	4	12	1.Blind to be provide in steam line to avoid human error/over heating. 2.Flash alarm to be provide on HH value of TI of ANFD.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 11		Node Description : 041ANFD-008									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
4	Level	Low	ANFD leakage, Ml transferring line valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. ANFD design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the ANFD. 2. Double earthing/grounding is provided to the ANFD. 3. Antistatic scrapper is used for unloading,	3	3	9				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 11		Node Description : 041ANFD-008									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Leakage spillage	Human error	Fire hazard Health Hazard	1.Line testing is performed before start-up. 2.Spill kit is available in the plant to 3.contain spillage in case of leakage. 4.Cartridge mask & PVC suit is used while filling powder.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 12		Node Description : Coupling Reactor(042RT-094)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Crystallization in coupling reactor(042RT-094)										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of sparkler filter is not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flange guard is provided in transferring line. 3.Line pressure test is performed before startup.	3	1	3	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.			
			Human error (manual valve of ML receiving line on coupling reactor is not opened).									
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage & fire hazard	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before start up. 3.Compatible gasket to be used to prevent gasket leakage.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date-07/12/2023			
Node 12		Node Description : Coupling Reactor(042RT-094)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1. Spill kit to be provided at nearby area to contain the spillage.	3	3	9	Blind to be provided to all drain point open end flanges.	2	3	6
			Low level in ANFD-008	No HSE hazard/Process Delay	No existing safeguard	3	1	3				
		High/More	No probable cause									
		Reverse	Pump trip/stop	Pump mechanical failure	1.NRV is provided in pump discharge line.	3	2	6				
		Mis-directed flow	Wrong line-up(Line up in ANFD inplace of coupling reactor)	No HSE hazard/Process delay								
2	Pressure	Low	No probable cause									
		High	Human Error (Vent line/vapour line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12	1. Interlock to be provided to stop the ml transferring pump from sparkler filter at HH value of PT of reactor 2.Flash alarm to be provide on HH alarm of PT of the reactor.	2	4	8
			Flame arrestor chocked		PM of flame arrestor is performed before startup.	3	4	12	PM of flame arrestor is performed as per	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 12		Node Description : Coupling Reactor(042RT-094)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									predefined schedule.			
3	Temperature	Low	No probable cause									
		High	Human error(steam line manual valve open passed)	Temperature rise may possible in the reactor	1.TI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation.	3	4	12	1.Steam line to be blinded to avoid human error. 2.Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up.	3	3	9	1. N2 inertisation to be performed during charging.	2	3	6
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	2	6	1.Chilling water supply line ROV air failed safe position is air failed to open condition.	3	2	6
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 12		Node Description : Coupling Reactor(042RT-094)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 13		Node Description : 041ANFD-010									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Filtration & Drying in 041ANFD-010										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	Nitrogen supply line valve pass	1.Ml transferring line may pressurise and leakage 2.Fire hazard due to spillage	1.Trained manpower will operate. 2.PT is available in ANFD with high and high high alarms. 3.Line pressure testing is being performed before start-up. 4.PRV is also available in N2 supply line. 5.N2 supply maximum pressure is up to 3 bar. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 13		Node Description : 041ANFD-010									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the ANFD	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the ANFD with high and high high alarms. 5. TI is available in the ANFD with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the ANFD. 4. Flash alarm to be provided at HH temperature and HH pressure of the ANFD.	2	4	8
		High	TCV failure/stuck open	ANFD may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in ANFD	3	4	12	1.Flash alarm to be provide on HH value of PT of the ANFD.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023		
Node 13		Node Description : 041ANFD-010									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with high and high high alarm.							
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.ANFD design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard		3	1	3				
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to ANFD. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the ANFD with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 13		Node Description : 041ANFD-010									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									temperature of the ANFD. 4. Flash alarm to be provided at HH temperature of the ANFD.			
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 13		Node Description : 041ANFD-010									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
4	Level	Low	ANFD leakage, Ml transferring line valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. ANFD design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage. 6.Fire extinguisher and fire hydrant point is available in near by area. 7.All electrical installation as per HAC classification.	3	3	9				
		High	Refer high Flow									
5	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed in the ANFD. 2. Double earthing/grounding is provided to the ANFD. 3. Antistatic scrapper is used for unloading,	3	3	9				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 13		Node Description : 041ANFD-010									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Leakage spillage	Human error	Fire hazard Health Hazard	1.Line testing is performed before start-up. 2.Spill kit is available in the plant to 3.contain spillage in case of leakage. 4.Cartridge mask & PVC suit is used while filling powder.	3	3	9				
		Instrument Air failure	Air compressor failure	ANFD may pressurise &Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum line air failed safe position is air failed to closed condition. 3.ROV of vacuum line air failed safe position is air failed to open condition.	2	4	8
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 14		Node Description : ANFD ML storage tank(040ST-148)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Material loading and unloading in ANFD ML storage tank										
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	No HSE hazard								
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT of the tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 14		Node Description : ANFD ML storage tank(040ST-148)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					low and low low alarm.							
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before start up.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on LS activation of storage tank.	2	3	6
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before start up.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on HH value of LI of the storage tank.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 14		Node Description : ANFD ML storage tank(040ST-148)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.			
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.Local vent is provided in	3	4	12	1.Double manual valve to be provide in N2 line.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023			
Node 14		Node Description : ANFD ML storage tank(040ST-148)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					storage tank.							
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.Local vent is provided in storage tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 14		Node Description : ANFD ML storage tank(040ST-148)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH						Plant Name: Plant-4, Date- 07/12/2023				
Node 15		Node Description : S-2 Toluene recovery reactor(043RT-096)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream -1		S-2 Toluene recovery reactor(043RT-096)										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 15		Node Description : S-2 Toluene recovery reactor(043RT-096)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023
Node 15	Node Description : S-2 Toluene recovery reactor(043RT-096)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8
		High Vacuum	No probable cause	No HSE hazard								
3	Temperature	Low	Human error(cooling water supply line valve open/passed)	No HSE hazard								

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023
Node 15	Node Description : S-2 Toluene recovery reactor(043RT-096)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date- 07/12/2023			
Node 15		Node Description : S-2 Toluene recovery reactor(043RT-096)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					before start operation.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	12				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High	Jacket puncture of the reactor	Reactor may overflow and chances of spillage/leakage	Before startup spark test & thickness testing is performed.	3	3	9				
5	Compositio n	Other than	No probable cause									

P &ID number : 8203/4TACH-STAGE-1/001	Title : HAZOP Study Of 4TACH	Plant Name: Plant-4, Date- 07/12/2023
Node 15	Node Description : S-2 Toluene recovery reactor(043RT-096)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Earthing jumper is provided in flange joint of solvent transferring line	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise &Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.	2	4	8
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 16		Node Description : Recovered AESOL-T tank (040ST-149)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Material loading and unloading in AESOL-T storage tank										
1	Quantity/Flow	No/Less	Line/Flange leakage Human Error (Discharge Valve not opened)	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT of the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 16		Node Description : Recovered AESOL-T tank (040ST-149)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LS is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on LS activation of storage tank.	2	3	6
			LS malfunctioning		1.LI is provided with alarms on storage tank . 2.PM of critical instrument is performed before startup.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage. 2.Flash alarm to be provided on HH value of LI of the storage tank.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed	No probable cause	-	-				-			

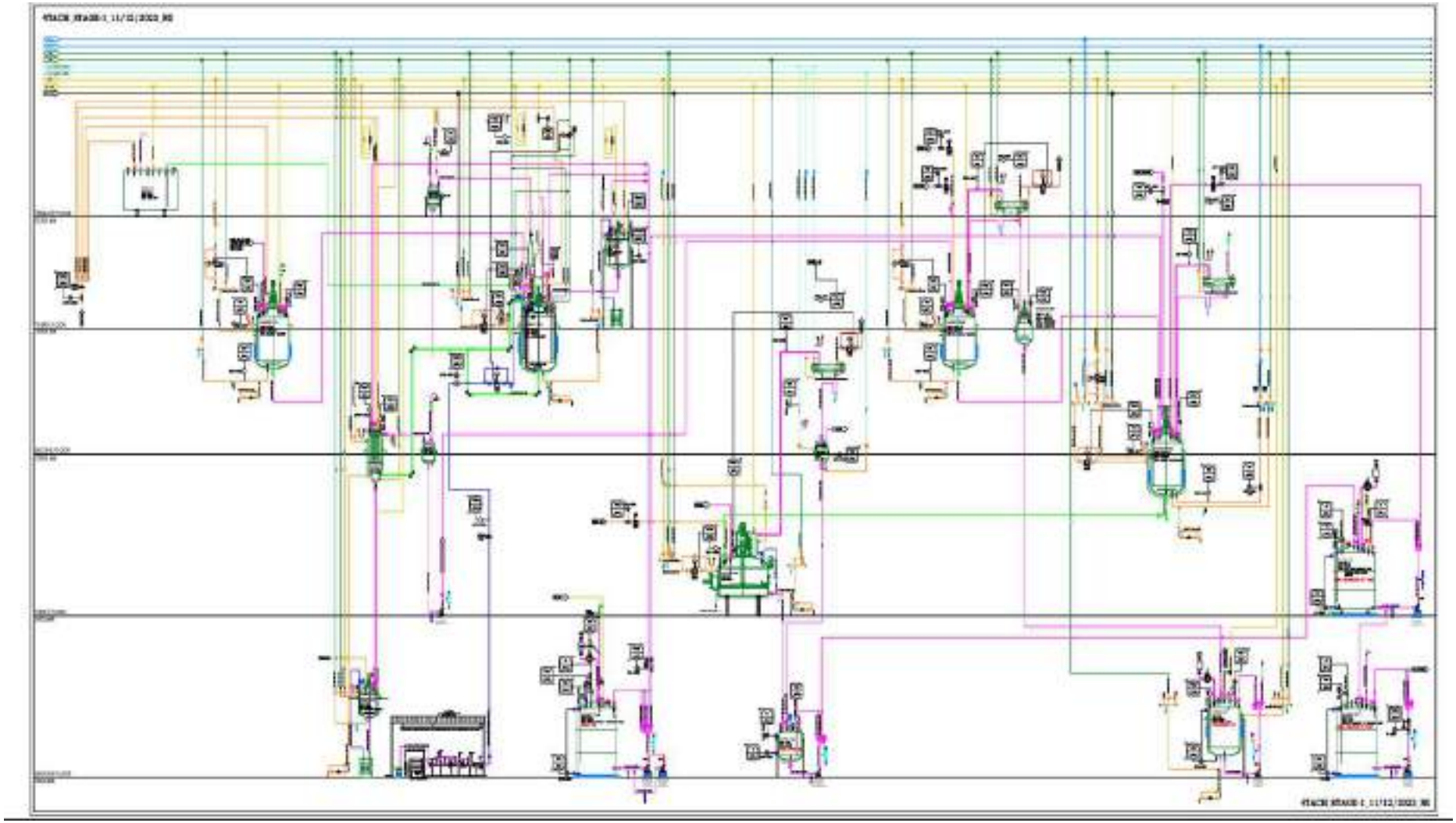
P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 16		Node Description : Recovered AESOL-T tank (040ST-149)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		flow										
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8

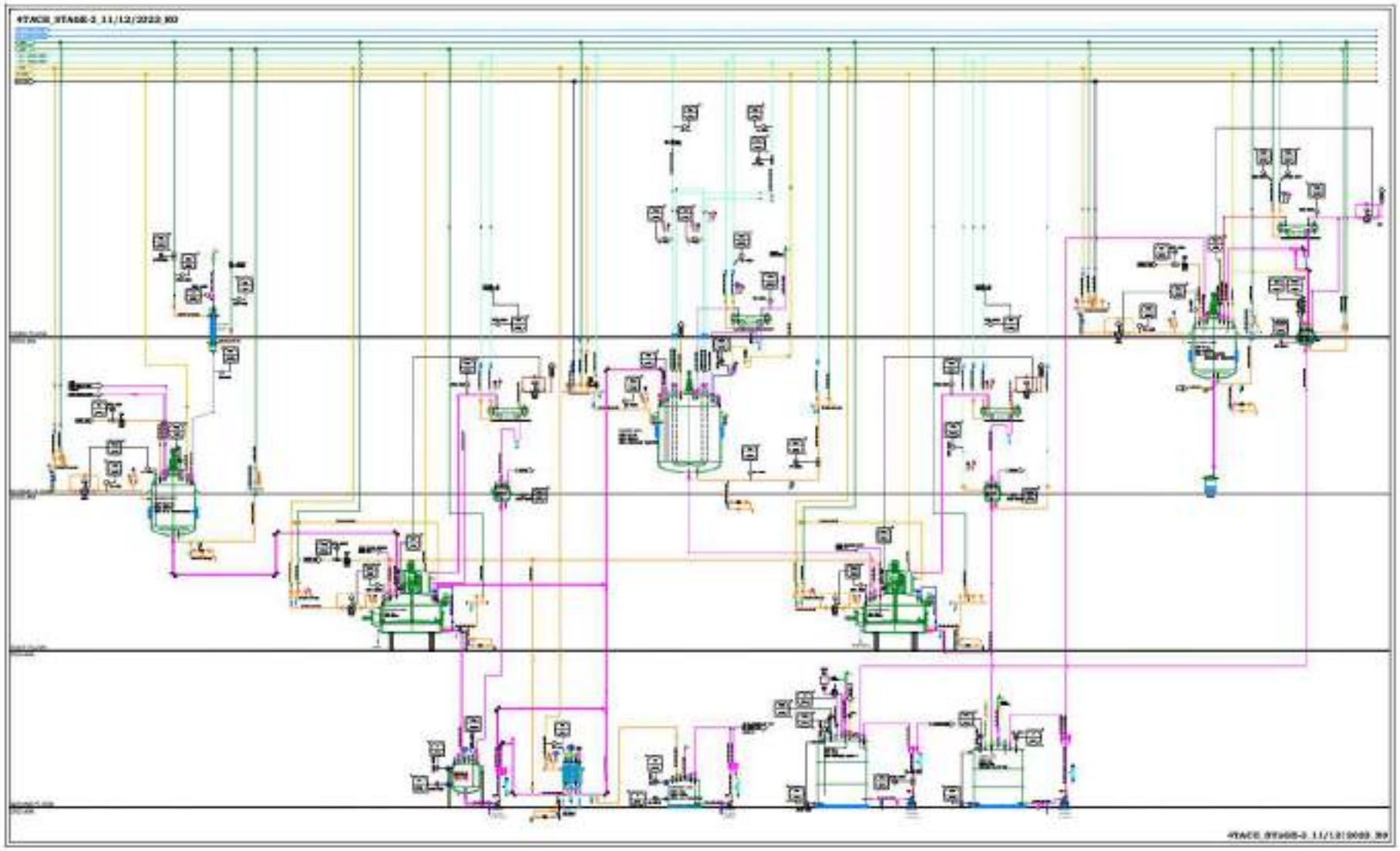
P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 16		Node Description : Recovered AESOL-T tank (040ST-149)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 16		Node Description : Recovered AESOL-T tank (040ST-149)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			N2 line manual valve pass	Tank may pressurise	1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Double manual valve to be provide in N2 line.	2	4	8
			N2 PRV failure	Tank may pressurise	1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6

P &ID number : 8203/4TACH-STAGE-1/001		Title : HAZOP Study Of 4TACH							Plant Name: Plant-4, Date-07/12/2023			
Node 16		Node Description : Recovered AESOL-T tank (040ST-149)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
5	Composition	Other than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

APPENDIX-2: P&ID DIAGRAMS





|| END OF THE REPORT ||

4-TACH HAZOP Report Recommendations Status						
Recommendations						
Node	Stream	Sr. No.	Pure IPA storage tank(046ST-166)	Status	Action Taken	Page Ref. No
Material loading and unloading in IPA storage tank						
Node 1	Stream-1	1	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-1	2	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 1	Stream-1	3	1.Recommend to provide overload tripping on pump.	Completed	Implemented in Field	45
Node 1	Stream-1	4	1.Recommend to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	2
Node 1	Stream-1	5	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-1	6	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 1	Stream-1	7	2. Flash alarm to be provided on LL value of PT o the tank.	Completed	Implemented in DCS	7
Node 1	Stream-1	8	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in DCS	8
Node 1	Stream-1	9	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	9
Node 1	Stream-1	10	1.Double mechanical seal to be provide in pump.	Completed	Implemented in Field	4
Node 1	Stream-1	11	1. Recommended to provide interlock to stop transfering pump at HH alarm value of LI of storage reactor.	Completed	Implemented in DCS	8
Node 1	Stream-1	12	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-1	13	3.Flash alarm to be provided on HH alarm value of LI of storage tank.	Completed	Implemented in DCS	7
Node 1	Stream-1	14	4.Flash alarm to be provided on LS activation of storage tank.	Completed	Implemented in DCS	7
Node 1	Stream-1	15	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 1	Stream-1	16	2. Flash alarm to be provided on LL value of PT o the tank.	Completed	Implemented in DCS	7
Node 1	Stream-1	17	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in DCS	8
Node 1	Stream-1	18	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	9
Node 1	Stream-1	19	1.PVRV PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	10
Node 1	Stream-1	20	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 1	Stream-1	21	2. Flash alarm to be provided on HH alarm value of PT of the storage tank.	Completed	Implemented in DCS	7
Node 1	Stream-1	22	3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.	Completed	Implemented in DCS	8
Node 1	Stream-1	23	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	9
Node 1	Stream-1	24	1.PVRV PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	10
Node 1	Stream-1	25	1.Double manual valve to be provide in N2 line.	Completed	Implemented in Field	5
Node 1	Stream-1	26	1.PM to be performed of PRV as per predefined schedule.	Completed	Implemented in Field	10
Node 1	Stream-1	27	1.Thickness testing of tank to be performed as per predefined schedule.	Completed	Implemented in Field	11
Node 1	Stream-1	28	1.Double manual valve to be provide at bottom of the tank.	Completed	Implemented in Field	2
Node Description : Slurry reactor(043RT-111)						
Node 2	Stream-1		IPA charging in slurry reactor[043RT-111] from IPA storage tank(046ST-166)			
Node 2	Stream-1	29	1.Spil kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 2	Stream-1	30	2.Line design pressure need to be confirmed before start-up.	Completed	Implemented in Field	6
Node 2	Stream-1	31	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 2	Stream-1	32	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 2	Stream-1	33	2.Line design pressure need to be confirmed before start-up.	Completed	Implemented in Field	6
Node 2	Stream-1	34	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 2	Stream-1	35	Blind to be provided to all drain point open end flanges.	Completed	Implemented in Field	12
Node 2	Stream-1	36	Upper limit of the totaliser to be freezed.	Completed	Implemented in DCS	8
Node 2	Stream-1	37	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor and same XV to be closed after 20 sec of pump stop.	Completed	Implemented in DCS	8
Node 2	Stream-1	38	2.Flash alarm to be provide on HH alarm of PT of the reactor.	Completed	Implemented in DCS	7
Node 2	Stream-1	39	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 2	Stream-1	40	2.Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	7
Node 2	Stream-1	41	3.Steam line to be blinded in slurry reactor.	Completed	Implemented in Field	14
Node 2	Stream-1	42	1.TCV bypass valve should be looked closed condition with tagging.	Completed	Implemented in Field	15
Node 2	Stream-1	43	1. N2 inertisation to be performed during charging.	Completed	Implemented in Field	-
Node 2	Stream-1	44	1.Recommend to provide interlock that if XV closed in transferring line than same time transferring pump to be stop.	Completed	Implemented in DCS	8
Node 2	Stream-1	45	2.IPA charging line XV air failed safe position to be air failed to closed condition.	Completed	Implemented in Field	-
Node Description : Autoclave(043RT-112)						
Node 4	Stream-1		Hydrogenation reaction			
Node 4	Stream-1	46	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 4	Stream-1	47	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 4	Stream-1	48	1.Flash alarm to be provide on HH value of H2 pressure.	Completed	Implemented in DCS	7

Node 4	Stream-1	49	2.Flash alarm to be provide on HH value of PT of the autoclave.	Completed	Implemented in DCS	7
Node 4	Stream-1	50	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 4	Stream-1	51	2.Flash alarm to be provide on HH value of PT of the reactor.	Completed	Implemented in DCS	7
Node 4	Stream-1	52	1.Recommend to provide dual RTD in reaction reactor and if difference between both RTD is more than 5 degree Celcius than pl interlock provided on primary RTD to be activated.	Completed	Implemented in DCS	84
Node 4	Stream-1	53	2.PM to be performed as per predefined schedule.	Completed	Implemented in Field	16
Node 4	Stream-1	54	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 4	Stream-1	55	2.Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	7
Node 4	Stream-1	56	1.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.	Completed	Implemented in DCS	8
Node 4	Stream-1	57	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	13
Node 4	Stream-1	58	1.Steam supply line TCV,H2 line ROV & PCV air failed safe position is air failed to closed condition.	Completed	Implemented in Field	-
Node 4	Stream-2	59	Filtration in candle filter(042CF-002)			
Node 4	Stream-2	60	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 4	Stream-2	61	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	6
Node 4	Stream-2	62	1.Recommended to manually observe the level autoclave.	Completed	Implemented in Field	-
Node 4	Stream-2	63	1.Flash alarm to be provide on HH value of PT of the candle filter.	Completed	Implemented in DCS	7
Node 4	Stream-2	64	1.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node Description : IPA recovery reactor(043RT-088)						
Node 5	Stream-1		Solvent recovery from IPA recovery reactor(043RT-088)			
Node 5	Stream-1	65	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 5	Stream-1	66	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 5	Stream-1	67	1.Recommend to provide overload tripping on pump.	Completed	Implemented in Field	40
Node 5	Stream-1	68	1.Recommend to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	2
Node 5	Stream-1	69	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 5	Stream-1	70	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 5	Stream-1	71	2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 5	Stream-1	72	3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	17
Node 5	Stream-1	73	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	7
Node 5	Stream-1	74	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops.	Completed	Implemented in DCS	17
Node 5	Stream-1	75	2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 5	Stream-1	76	3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor.	Completed	Implemented in DCS	17
Node 5	Stream-1	77	4. Flash alarm to be provided at HH temperature of the reactor.	Completed	Implemented in DCS	7
Node 5	Stream-1	78	1.PM of TCV is to be performed as per predefined schedule.	Completed	Implemented in Field	13
Node 5	Stream-1	79	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	15
Node 5	Stream-1	80	1. Double manual valve to be provide to prevent valve passing.	Completed	Implemented in Field	2
Node 5	Stream-1	81	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 5	Stream-1	82	1.TCV of steam line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
Node 5	Stream-1	83	2.PCV of vacuum pot air fail safe position to be air fail to close.	Completed	Implemented in Field	-
Node 5	Stream-1	84	3.ROV of vacuum line air fail safe position to be air fail to open.	Completed	Implemented in Field	-
Node 5	Stream-1	85	1.Agitator no load tripping to be provided.	Completed	Implemented in DCS	55
Node 5	Stream-1	86	2.Steam TCV to be closed in case of agitator stop/trip.	Completed	Implemented in DCS	17
Node Description : Crude Crystalizer(042RT-093)						
Node 6	Stream-1		Heating & Maintaining in crude crystalizer(042RT-093)			
Node 6	Stream-1	87	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 6	Stream-1	88	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 6	Stream-1	89	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 6	Stream-1	90	2.Flash alarm to be provide on HH value of PT of the reactor.	Completed	Implemented in DCS	7
Node 6	Stream-1	91	1.Double valve to be provided in N2 supply line.	Completed	Implemented in Field	5
Node 6	Stream-1	92	1.Recommend to provide interlock to closed the steam TCV at HH value of PT of the reactor.	Completed	Implemented in DCS	18
Node 6	Stream-1	93	PM of flame arrestor is performed as per predefined schedule	Completed	Implemented in Field	19
Node 6	Stream-1	94	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 6	Stream-1	95	2.Flash alarm to be provide on HH value of TI of the reactor.	Completed	Implemented in DCS	7
Node 6	Stream-1	96	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor.	Completed	Implemented in DCS	18
Node 6	Stream-1	97	2.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.	Completed	Implemented in DCS	18
Node 6	Stream-1	98	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	15
Node 6	Stream-1	99	1.PM to be performed as per predefined schedule.	Completed	Implemented in Field	20
Node 6	Stream-1	100	1.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
Node 6	Stream-1	101	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	6
Node 6	Stream-1	102	3.Compatible gasket to be used prevent gasket leakage.	Completed	Implemented in Field	-

Node 6	Stream-1	103	1.Double manual valve to be provided at bottom of the reactor.	Completed	Implemented in Field	2
Node 6	Stream-1	104	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.	Completed	Implemented in Field	21
Node 6	Stream-1	105	1.TCV of steam line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
Node 6	Stream-1	106	1.Agitator no load tripping to be provided.	Completed	Implemented in DCS	47
Node 6	Stream-1	107	2.Steam TCV to be closed in case of agitator stop/trip.	Completed	Implemented in DCS	18
			Node Description : 041ANFD-009			
Node 7	Stream-1		Filtration & Drying in 041ANFD-009			
Node 7	Stream-1	108	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	22
Node 7	Stream-1	109	2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	22
Node 7	Stream-1	110	3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the ANFD.	Completed	Implemented in DCS	22
Node 7	Stream-1	111	4. Flash alarm to be provided at HH temperature and HH pressure of the ANFD.	Completed	Implemented in DCS	7
Node 7	Stream-1	112	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops.	Completed	Implemented in DCS	22
Node 7	Stream-1	113	2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	22
Node 7	Stream-1	114	3. Interlock to be provided to stop steam line TCV at HH temperature of the ANFD.	Completed	Implemented in DCS	22
Node 7	Stream-1	115	4. Flash alarm to be provided at HH temperature of the ANFD.	Completed	Implemented in DCS	7
Node 7	Stream-1	116	1.PM of TCV is to be performed as per predefined schedule.	Completed	Implemented in Field	13
Node 7	Stream-1	117	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	16
Node 7	Stream-1	118	1.TCV of steam line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
Node 7	Stream-1	119	2.PCV of vacuum line air failed safe position is air failed to closed condition.	Completed	Implemented in Field	-
Node 7	Stream-1	120	3.ROV of vacuum line air failed safe position is air failed to open condition.	Completed	Implemented in Field	-
Node 7	Stream-1	121	1.Agitator no load tripping to be provided.	Completed	Implemented in DCS	48
Node 7	Stream-1	122	2.Steam TCV to be closed in case of agitator stop/trip.	Completed	Implemented in DCS	23
			Node Description : Separation storage tank (041ST-137)			
Node 8	Stream-1		Material loading and unloading in separation storage tank			
Node 8	Stream-1	123	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 8	Stream-1	124	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 8	Stream-1	125	1.Recommend to provide overload tripping on pump.	Completed	Implemented in DCS	48
Node 8	Stream-1	126	1.Recommend to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	2
Node 8	Stream-1	127	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 8	Stream-1	128	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 8	Stream-1	129	2. Flash alarm to be provided on LL value of PT of the tank.	Completed	Implemented in DCS	7
Node 8	Stream-1	130	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in DCS	24
Node 8	Stream-1	131	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	25
Node 8	Stream-1	132	1.Double mechanical seal to be provide in pump.	Completed	Implemented in Field	4
Node 8	Stream-1	133	1. Recommended to provide interlock to stop transferring pump at LS activation.	Completed	Implemented in DCS	24
Node 8	Stream-1	134	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 8	Stream-1	135	3.Flash alarm to be provided on LS activation of storage tank.	Completed	Implemented in DCS	7
Node 8	Stream-1	136	1. Recommended to provide interlock to stop transferring pump at HH value of LI of the storage tank.	Completed	Implemented in Field	24
Node 8	Stream-1	137	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 8	Stream-1	138	3.Flash alarm to be provided on HH value of LI of the storage tank.	Completed	Implemented in DCS	7
Node 8	Stream-1	139	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 8	Stream-1	140	2. Flash alarm to be provided on LL value of PT o the tank.	Completed	Implemented in DCS	7
Node 8	Stream-1	141	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in DCS	24
Node 8	Stream-1	142	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	29
Node 8	Stream-1	143	1.PVRV PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	29
Node 8	Stream-1	144	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 8	Stream-1	145	2. Flash alarm to be provided on HH alarm value of PT of the storage tank.	Completed	Implemented in DCS	7
Node 8	Stream-1	146	3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.	Completed	Implemented in DCS	24
Node 8	Stream-1	147	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	25
Node 8	Stream-1	148	1.PVRV PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	29
Node 8	Stream-1	149	1.Double manual valve to be provide in N2 line.	Completed	Implemented in Field	5
Node 8	Stream-1	150	1.PM to be performed of PRV as per predefined schedule.	Completed	Implemented in Field	28
Node 8	Stream-1	151	1.Thickness testing of tank to be performed as per precefined schedule.	Completed	Implemented in Field	27
Node 8	Stream-1	152	1.Double manual valve to be provide at bottom of the tank.	Completed	Implemented in Field	2
			Node Description : Aqueous storage tank(040ST-157)			
Node 9	Stream-1		Aqueous storage tank(040ST-157)			
Node 9	Stream-1	153	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 9	Stream-1	154	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 9	Stream-1	155	1.Recommend to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	2

Node 9	Stream-1	156	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 9	Stream-1	157	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 9	Stream-1	158	1.Flame arrestor PM to be performedas per pre-defined schedule.	Completed	Implemented in Field	28
Node 9	Stream-1	159	1. Recommended to provide interlock to stop transferring pump at LS activation.	Completed	Implemented in Field	24
Node 9	Stream-1	160	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 9	Stream-1	161	3.Flash alarm to be provided on LS activation of storage tank.	Completed	Implemented in DCS	29
Node 9	Stream-1	162	1. Recommended to provide interlock to stop transferring pump at HH value of LI of the storage tank.	Completed	Implemented in Field	24
Node 9	Stream-1	163	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 9	Stream-1	164	3.Flash alarm to be provided on HH value of LI of the storage tank.	Completed	Implemented in DCS	29
Node 9	Stream-1	165	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 9	Stream-1	166	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	28
Node 9	Stream-1	167	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 9	Stream-1	168	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	28
Node 9	Stream-1	169	1.Thickness testing of tank to be performed as per predefined schedule.	Completed	Implemented in Field	30
Node 9	Stream-1	170	1.Double manual valve to be provide at bottom of the tank.	Completed	Implemented in Field	2
			Node Description : S-2 Purification reactor(042RT-087)			
Node 10	Stream-1		**Toluene charging in S-2 purification reactor(042RT-087) from storage tank**			
Node 10	Stream-1	171	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 10	Stream-1	172	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	6
Node 10	Stream-1	173	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 10	Stream-1	174	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 10	Stream-1	175	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	6
Node 10	Stream-1	176	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 10	Stream-1	177	Blind to be provided to all drain point open end flanges.	Completed	Implemented in Field	12
Node 10	Stream-1	178	Upper limit of the totaliser to be freezed.	Completed	Implemented in DCS	31
Node 10	Stream-1	179	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor and same XV to be closed after 20 sec of pump stop.	Completed	Implemented in DCS	31
Node 10	Stream-1	180	2.Flash alarm to be provide on HH alarm of PT of the reactor.	Completed	Implemented in DCS	29
Node 10	Stream-1	181	PM of flame arrestor is performed as per predefine schedule.	Completed	Implemented in Field	32
Node 10	Stream-1	182	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 10	Stream-1	183	2.Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	29
Node 10	Stream-1	184	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in DCS	15
Node 10	Stream-1	185	1. N2 inertisation to be performed during charging.	Completed	Implemented in Field	-
Node 10	Stream-1	186	1.Recommend to provide interlock that if XV closed in transferring line then same time transferring pump to be stop.	Completed	Implemented in DCS	31
Node 10	Stream-1	187	2.Toluene charging line XV air failed safe position to be air failed to closed condition.	Completed	Implemented in Field	-
Node 10	Stream-3		**Heating & reflux in S-2 purification reactor(042RT-087)**			
Node 10	Stream-3	188	1.Flash alarm to be provide on HH value of PT of the reactor.	Completed	Implemented in DCS	29
Node 10	Stream-3	189	1.Double valve to be provided in N2 supply line.	Completed	Implemented in Field	6
Node 10	Stream-3	190	1.Recommend to provide interlock to closed the steam TCV at HH value of PT of the reactor.	Completed	Implemented in DCS	33
Node 10	Stream-3	191	PM of flame arrestor is performed asper predefine schedule	Completed	Implemented in Field	32
Node 10	Stream-3	192	1.PM of TCV to be carried out as per predefined schedule.	Completed	Implemented in Field	13
Node 10	Stream-3	193	2.Flash alarm to be provide on HH value of TI of the reactor.	Completed	Implemented in DCS	29
Node 10	Stream-3	194	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor.	Completed	Implemented in DCS	33
Node 10	Stream-3	195	2.Recommended to provide upper limit of TCV set value to be freeze as per process requirement.	Completed	Implemented in DCS	33
Node 10	Stream-3	196	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	15
Node 10	Stream-3	197	1.PM to be performed as per predefined schedule.	Completed	Implemented in Field	34
Node 10	Stream-3	198	1.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
Node 10	Stream-3	199	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	6
Node 10	Stream-3	200	3.Compatible gasket to be used prevent gasket leakage.	Completed	Implemented in Field	-
Node 10	Stream-3	201	1.Double manual valve to be provided at bottom of the reactor.	Completed	Implemented in Field	2
Node 10	Stream-3	202	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.	Completed	Implemented in Field	35
Node 10	Stream-3	203	1.TCV of steam line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
Node 10	Stream-3	204	1.Agitator no load tripping to be provided.	Completed	Implemented in DCS	50
Node 10	Stream-3	205	2.Steam TCV to be closed in case of agitator stop/trip.	Completed	Implemented in DCS	33
			Node Description : 041ANFD-006			
Node 11	Stream-1		**Hot Filtration in ANFD(041ANFD-006)**			
Node 11	Stream-1	206	1.Flash alarm to be provide on HH value of PT of the ANFD.	Completed	Implemented in DCS	29
Node 11	Stream-1	207	1.Blind to be provide in steam line to avoid human error/over heating.	Completed	Implemented in Field	14
Node 11	Stream-1	208	2.Flash alarm to be provide on HH value of TI of ANFD.	Completed	Implemented in DCS	29

			Node Description : Coupling Reactor(042RT-094)			
Node 12	Stream-1		**Crystallization in coupling reactor(042RT-094)**			
Node 12	Stream-1	209	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 12	Stream-1	210	2.Line design pressure need to be confirmed before start up.	Completed	Implemented in Field	6
Node 12	Stream-1	211	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 12	Stream-1	212	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 12	Stream-1	213	2.Line design pressure need to be confirmed before start up.	Completed	Implemented in Field	6
Node 12	Stream-1	214	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 12	Stream-1	215	Blind to be provided to all drain point open end flanges.	Completed	Implemented in Field	12
Node 12	Stream-1	216	1. Interlock to be provided to stop the ml transferring pump from sparkler filter at HH value of PT of reactor	Completed	Implemented in DCS	33
Node 12	Stream-1	217	2.Flash alarm to be provide on HH alarm of PT of the reactor.	Completed	Implemented in DCS	29
Node 12	Stream-1	218	PM of flame arrestor is performed as per predefined schedule.	Completed	Implemented in Field	36
Node 12	Stream-1	219	1.Steam line to be blinded to avoid human error.	Completed	Implemented in Field	14
Node 12	Stream-1	220	2.Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	29
Node 12	Stream-1	221	1. N2 inertisation to be performed during charging.	Completed	Implemented in Field	-
Node 12	Stream-1	222	1.Chilling water supply line ROV air failed safe position is air failed to open condition.	Completed	Implemented in Field	-
			Node Description : 041ANFD-010			
Node 13	Stream-1		**Filtration & Drying in 041ANFD-010**			
Node 13	Stream-1	223	2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in Field	22
Node 13	Stream-1	224	3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the ANFD.	Completed	Implemented in DCS	22
Node 13	Stream-1	225	4. Flash alarm to be provided at HH temperature and HH pressure of the ANFD.	Completed	Implemented in DCS	29
Node 13	Stream-1	226	1.Flash alarm to be provide on HH value of PT of the ANFD.	Completed	Implemented in DCS	29
Node 13	Stream-1	227	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops.	Completed	Implemented in DCS	32
Node 13	Stream-1	228	2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	22
Node 13	Stream-1	229	3. Interlock to be provided to stop steam line TCV at HH temperature of the ANFD.	Completed	Implemented in DCS	22
Node 13	Stream-1	230	4. Flash alarm to be provided at HH temperature of the ANFD.	Completed	Implemented in DCS	29
Node 13	Stream-1	231	1.PM of TCV is to be performed as per predefined schedule.	Completed	Implemented in Field	13
Node 13	Stream-1	232	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	16
Node 13	Stream-1	233	1.TCV of steam line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
Node 13	Stream-1	234	2.PCV of vacuum line air failed safe position is air failed to closed condition.	Completed	Implemented in Field	-
Node 13	Stream-1	235	3.ROV of vacuum line air failed safe position is air failed to open condition.	Completed	Implemented in Field	-
Node 13	Stream-1	236	1.Agitator no load tripping to be provided.	Completed	Implemented in DCS	51
Node 13	Stream-1	237	2.Steam TCV to be closed in case of agitator stop/trip.	Completed	Implemented in DCS	23
			Node Description : ANFD ML storage tank(040ST-148)			
Node 14	Stream-1		**Material loading and unloading in ANFD ML storage tank**			
Node 14	Stream-1	238	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 14	Stream-1	239	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 14	Stream-1	240	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 14	Stream-1	241	2. Flash alarm to be provided on LL value of PT of the tank.	Completed	Implemented in DCS	29
Node 14	Stream-1	242	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	38
Node 14	Stream-1	243	1.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 14	Stream-1	244	2.Flash alarm to be provided on LS activation of storage tank.	Completed	Implemented in DCS	29
Node 14	Stream-1	245	1.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 14	Stream-1	246	2.Flash alarm to be provided on HH value of LI of the storage tank.	Completed	Implemented in DCS	29
Node 14	Stream-1	247	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 14	Stream-1	248	2. Flash alarm to be provided on LL value of PT o the tank.	Completed	Implemented in DCS	29
Node 14	Stream-1	249	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in DCS	37
Node 14	Stream-1	250	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	38
Node 14	Stream-1	251	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 14	Stream-1	252	2. Flash alarm to be provided on HH alarm value of PT of the storage tank.	Completed	Implemented in DCS	29
Node 14	Stream-1	253	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	38
Node 14	Stream-1	254	1.PM to be performed of PRV as per predefined schedule.	Completed	Implemented in Field	-
Node 14	Stream-1	255	1.Thickness testing of tank to be performed as per predefined schedule.	Completed	Implemented in Field	38
Node 14	Stream-1	256	1.Double manual valve to be provide at bottom of the tank.	Completed	Implemented in Field	2
			Node Description : S-2 Toluene recovery reactor(043RT-096)			
Node 15	Stream -1		**S-2 Toluene recovery reactor(043RT-096)**			
Node 15	Stream -1	257	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 15	Stream -1	258	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 15	Stream -1	259	1.Recommend to provide overload tripping on pump.	Completed	Implemented in DCS	62

Node 15	Stream -1	260	1.Recommend to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	2
Node 15	Stream -1	261	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 15	Stream -1	262	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 15	Stream -1	263	2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 15	Stream -1	264	3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	17
Node 15	Stream -1	265	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	29
Node 15	Stream -1	266	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops.	Completed	Implemented in DCS	17
Node 15	Stream -1	267	2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 15	Stream -1	268	3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor.	Completed	Implemented in DCS	17
Node 15	Stream -1	269	4. Flash alarm to be provided at HH temperature of the reactor.	Completed	Implemented in DCS	29
Node 15	Stream -1	270	1.PM of TCV is to be performed as per predefined schedule.	Completed	Implemented in Field	13
Node 15	Stream -1	271	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	15
Node 15	Stream -1	272	1. Double manual valve to be provide to prevent valve passing.	Completed	Implemented in Field	2
Node 15	Stream -1	273	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 15	Stream -1	274	1.TCV of steam line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
Node 15	Stream -1	275	2.PCV of vacuum pot air fail safe position to be air fail to close.	Completed	Implemented in Field	-
Node 15	Stream -1	276	3.ROV of vacuum line air fail safe position to be air fail to open.	Completed	Implemented in Field	-
Node 15	Stream -1	277	1.Agitator no load tripping to be provided.	Completed	Implemented in DCS	53
Node 15	Stream -1	278	2.Steam TCV to be closed in case of agitator stop/trip.	Completed	Implemented in DCS	18
Node Description : Recovered AESOL-T tank (P-651-149)						
Node 16	Stream-1		Material loading and unloading in AESOL-T storage tank			
Node 16	Stream-1	279	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 16	Stream-1	280	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 16	Stream-1	281	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 16	Stream-1	282	2. Flash alarm to be provided on LL value of PT of the tank.	Completed	Implemented in DCS	40
Node 16	Stream-1	283	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in DCS	41
Node 16	Stream-1	284	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	42
Node 16	Stream-1	285	1.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 16	Stream-1	286	2.Flash alarm to be provided on LS activation of storage tank.	Completed	Implemented in DCS	40
Node 16	Stream-1	287	1.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
Node 16	Stream-1	288	2.Flash alarm to be provided on HH value of LI of the storage tank.	Completed	Implemented in DCS	40
Node 16	Stream-1	289	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 16	Stream-1	290	2. Flash alarm to be provided on LL value of PT o the tank.	Completed	Implemented in Field	40
Node 16	Stream-1	291	3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	Completed	Implemented in Field	41
Node 16	Stream-1	292	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	42
Node 16	Stream-1	293	1.PVRV PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	43
Node 16	Stream-1	294	1. Vent line manual valve to be in critical locked open condition with LO tag.	Completed	Implemented in Field	3
Node 16	Stream-1	295	2. Flash alarm to be provided on HH alarm value of PT of the storage tank.	Completed	Implemented in DCS	40
Node 16	Stream-1	296	1.Flame arrestor PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	42
Node 16	Stream-1	297	1.PVRV PM to be performed as per pre-defined schedule.	Completed	Implemented in Field	43
Node 16	Stream-1	298	1.Double manual valve to be provide in N2 line.	Completed	Implemented in Field	2
Node 16	Stream-1	299	1.PM to be performed of PRV as per predefined schedule.	Completed	Implemented in Field	-
Node 16	Stream-1	300	1.Thickness testing of tank to be performed as per predefined schedule.	Completed	Implemented in Field	44
Node 16	Stream-1	301	1.Double manual valve to be provide at bottom of the tank.	Completed	Implemented in Field	2

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	1	1
		5	
		12	
Node 2	Stream-1	29	
		32	
Node 4	Stream-1	46	
	Stream-2	60	
		64	
Node 5	Stream-1	65	
		69	
		81	
Node 6	Stream-1	87	
		100	
Node 8	Stream-1	123	
		127	
		134	
		137	
Node 9	Stream-1	153	
		156	
		160	
		163	
Node 10	Stream-1	171	
		174	
	Stream-3	198	
Node 12	Stream-1	209	
		212	
Node 14	Stream-1	238	
		243	
		245	
Node 15	Stream -1	257	
		261	
		273	
Node 16	Stream-1	279	
		285	
		287	

1

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2063

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Spill Kit



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Spill Kit



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Spill Kit



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2066

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Spill Kit

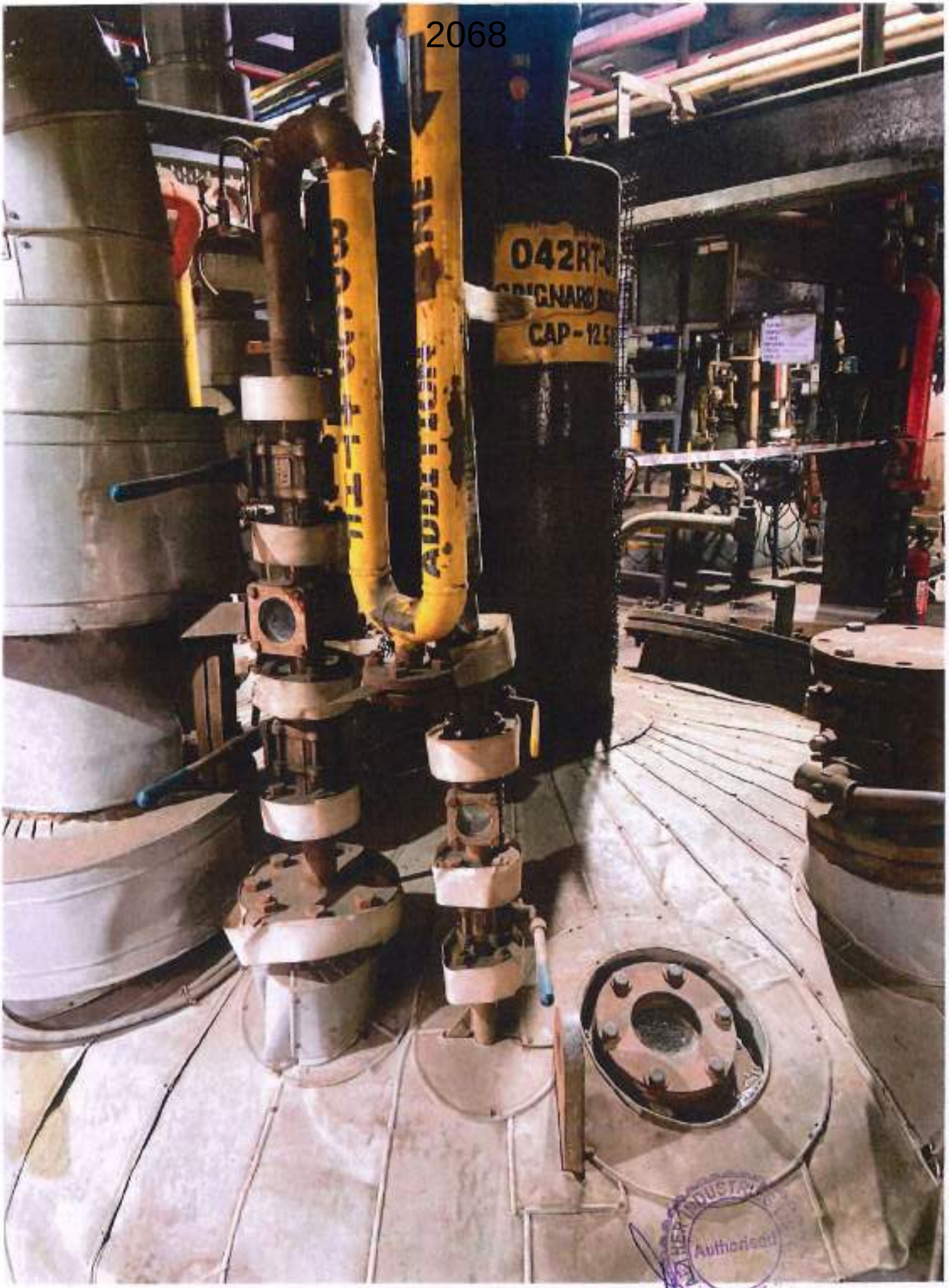


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Node	Stream	Sr. No.	Page Ref. No
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		28	
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		80	
Node 6	Stream-1	103	
Node 8	Stream-1	126	
		152	
Node 9	Stream-1	155	
		170	
Node 10	Stream-3	201	
Node 14	Stream-1	256	
Node 15	Stream -1	260	
		272	
Node 16	Stream-1	298	
		301	

2

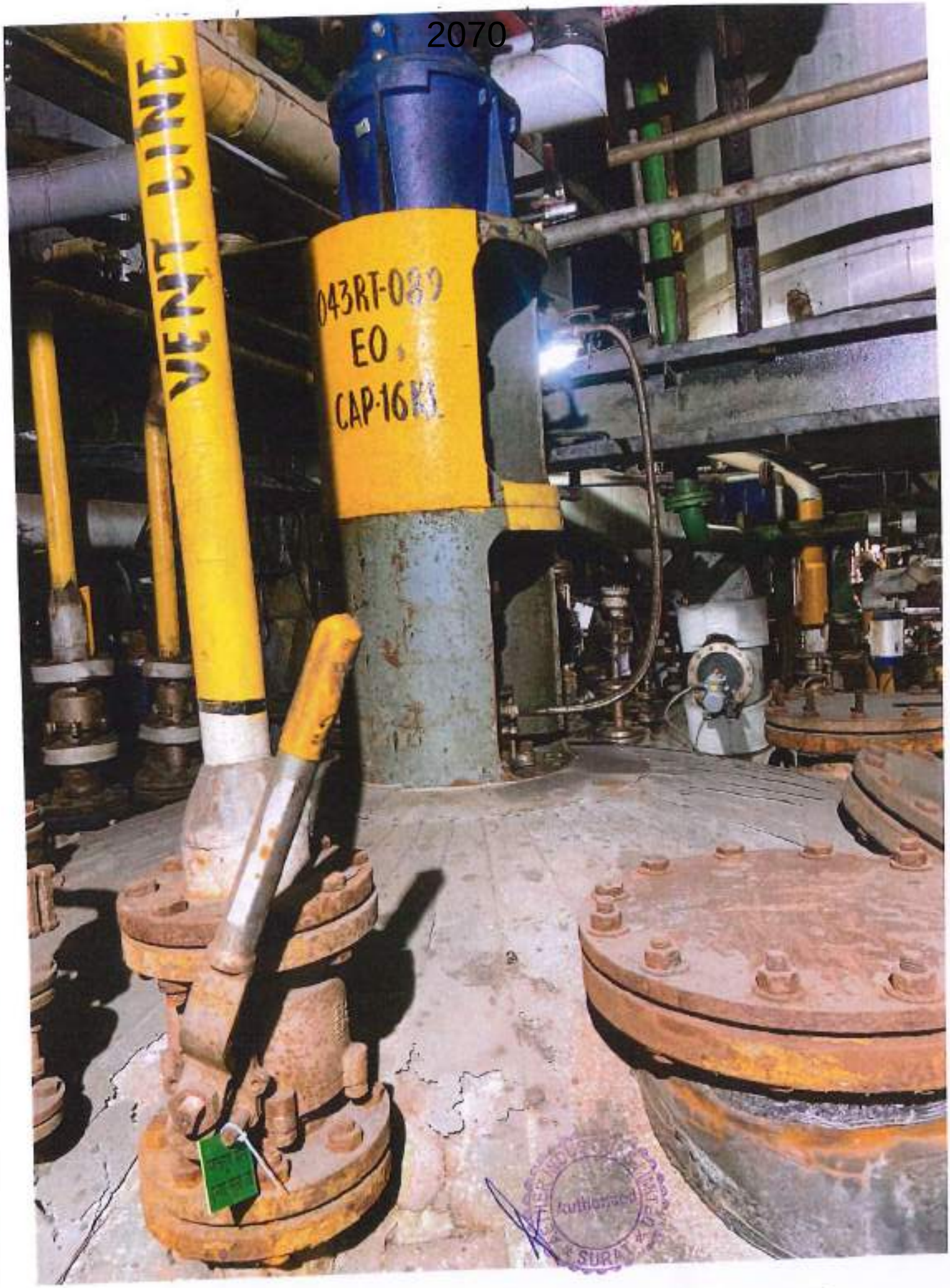
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042RT-
CAP-12
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Node	Stream	Sr. No.	Page Ref. No
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		15	
		20	
Node 8	Stream-1	128	
		139	
		144	
Node 9	Stream-1	157	
		165	
		167	
Node 14	Stream-1	240	
		247	
		251	
Node 16	Stream-1	281	
		289	
		294	

3

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VENT LINE
043RT-089
EO
CAP-16

2071

Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	10	4
Node 8	Stream-1	132	

4

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2072



Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	25	5
Node 6	Stream-1	91	
Node 8	Stream-1	149	
Node 10	Stream-3	189	

5

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2074



Node	Stream	Sr. No.	Page Ref. No
Node 2	Stream-1	30	6
		33	
Node 4	Stream-2	61	
Node 6	Stream-1	101	
Node 10	Stream-1	172	
		175	
	Stream-3	199	
Node 12	Stream-1	210	
		213	

6

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kmsteelindia@gmail.com
info@kmsteelindia.com
www.kmsteelindia.com
Skype : milap.jain1

K.M. STEEL INDIA

AN ISO 9001:2008 CERTIFIED COMPANY

Rgd. Office : 122/c, Gora Gandhi Building, 1st floor, Office No. 37, 8th Khetwadi Back Road, Mumbai - 400004.
Tel.: 022 66394590 / 66362239
Mob.: +91 9869714760 / 9892372108

P.M.I. TEST REPORT

CUSTOMER NAME: - Aether Industries Limited.

PAGE NO: - 180.

ADD: - Plot no-8203, Road No. 08, GIDC Industrial Estate
Sachin, Surat - 394 230 Gujarat, India.

LAB TEST DATE: - 05 / DEC / 2023.

Details As Per P.O Copy.

MAT.SPECIFICATION: – S.S. 304 SEAMLESS PIPE - 1" NB X SCH 40 – N230917AS12.

P.O.NO: – AIL/PO/23-24/6529.

MAT.SPECIFICATION: – S.S. 304 SEAMLESS PIPE – 1-1/2" NB X SCH 40 – N230917AS12.

DATE: – 05 / DEC / 2023.

MAT.SPECIFICATION: – S.S. 304 SEAMLESS PIPE – 2" NB X SCH 40 – N230917AS12.

Chemical Composition (%).

S No.	Size	C%	Mn%	P%	S%	Si%	Cr%	Ni%		
	MIN						18.00	8.00		
	MAX	0.08	2.00	0.75	0.045	0.85	20.00	12.00		
01)	S.S. 304 SEAMLESS PIPE - 1" NB X SCH 40.	0.05	1.17	0.61	0.041	0.019	18.23	8.26		
	S.S. 304 SEAMLESS PIPE – 1-1/2" NB X SCH 40.	0.50	1.13	0.60	0.040	0.017	18.14	8.29		
	S.S. 304 SEAMLESS PIPE - 2" NB X SCH 40.	0.61	1.16	0.55	0.030	0.020	18.09	8.42		

Results: – Satisfactory.

REMARK: – The Above Material Satisfactorily Conforms To The requirement -
Material Confirm As Per S.S. 304.

NOTES: – We Here By Certify That The Material Described Here In Has Been Manufactured In Accordance With The Above Specification.

K.M. STEEL INDIA

Production Executive / Manager.

Test Report End.

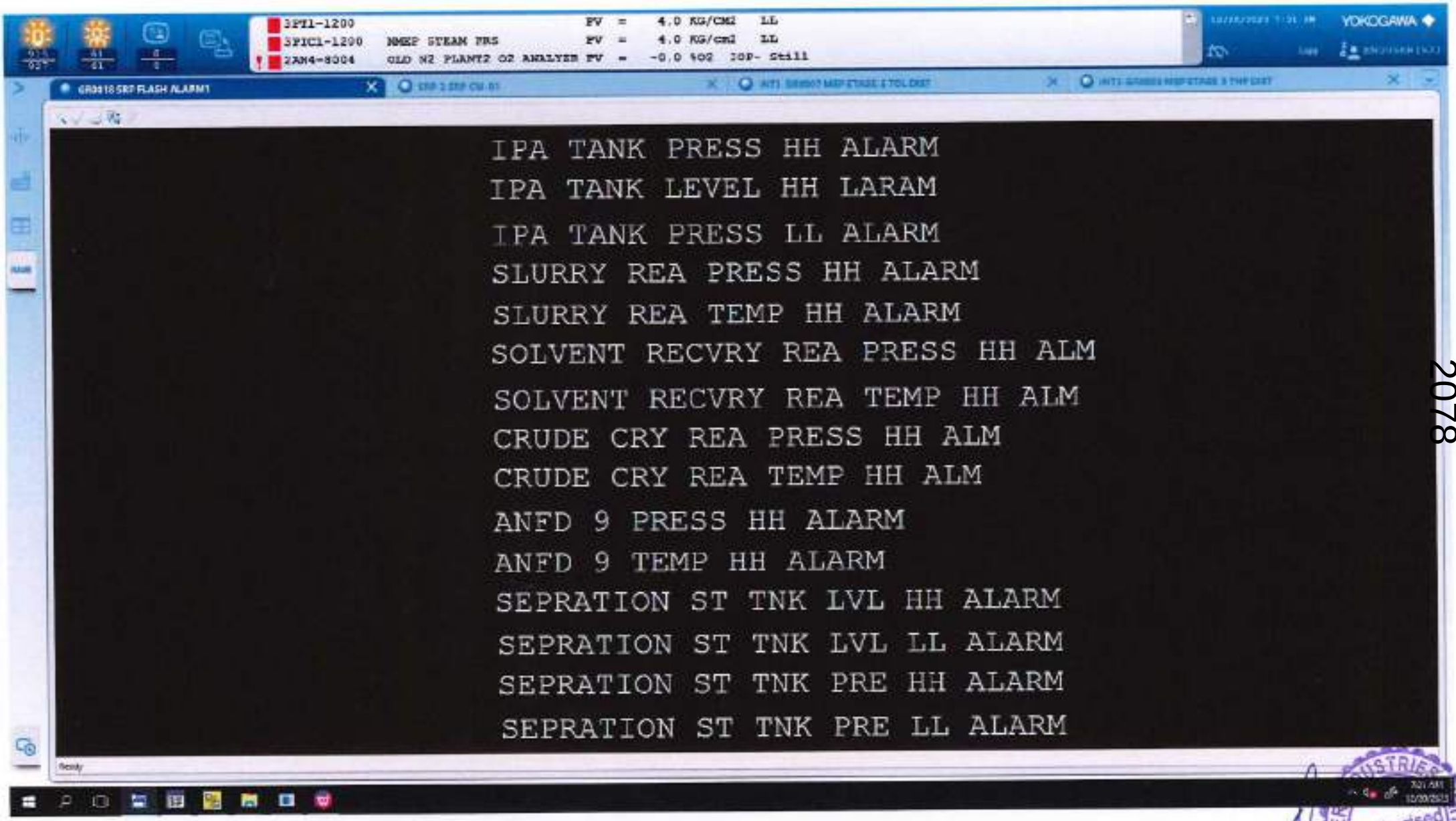
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MAKE IN INDIA

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		13	
		14	
		16	
		21	
Node 2	Stream-1	38	
		40	
Node 4	Stream-1	48	
		49	
		51	
		55	
	Stream-2	63	
Node 5	Stream-1	73	
		77	
Node 6	Stream-1	90	
		95	
Node 7	Stream-1	111	
		115	
Node 8	Stream-1	129	
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		138	
		140	
		145	

7





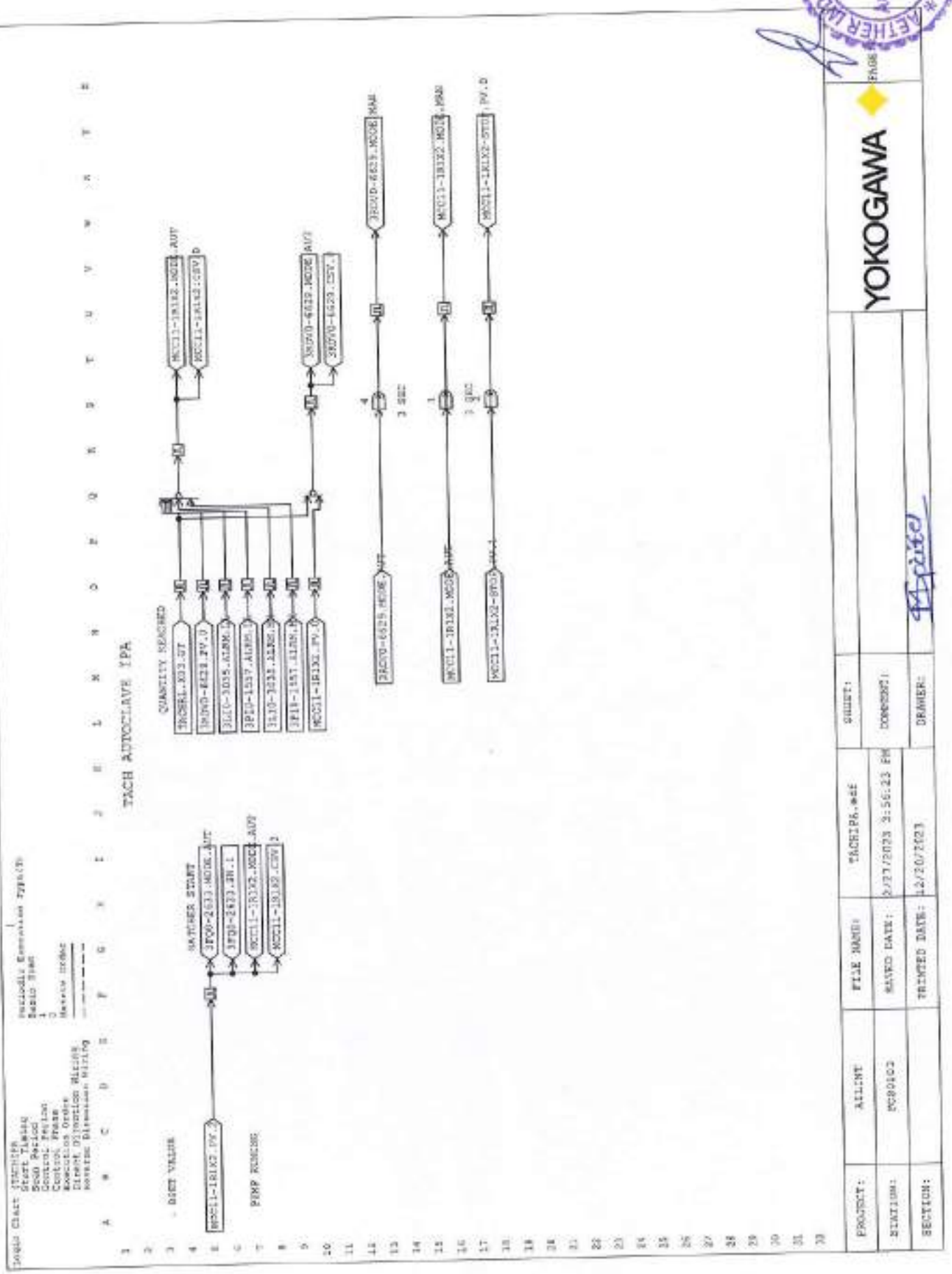
2078

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		11	
		17	
		22	
Node 2	Stream-1	36	
		37	
		44	
Node 4	Stream-1	56	

8

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TACH AUTOCLAVE YPA
QUANTITY READING
WATCHER START
PUMP RUNNING
YOKOGAWA
PROJECT:
AILINT
STATION:
SECTION:
FILE NAME:
TACH2P6.eSE
SHEET:
DRAWN:

Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	9	9
		18	
		23	

9

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : [illegible] Equipment TAG No : [illegible] Block : [illegible]			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		[illegible]
2	Check visual condition of flame element	OK	✓		[illegible]
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleaned	✓		[illegible]
4	Visually check Gasket condition	Checked	✓		[illegible]

Note:-

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	19	10
		24	
		26	

10



BREATHER VALVE CALIBRATION REPORT SHEET (PSM-P07)

Breather Valve I.D. number	[illegible]
Calibration Date	[illegible]
Calibration Due Date	[illegible]

Sr. No.	Check Point	Mark (√) where applicable
1	Check physical condition of breather valve?	
2	Check leakage test of breather valve?	
3	Compare pressure/vacuum reading at inlet and vent of breather valve. (Acceptance Limit: +/- 10% of full scale)	

Inlet pressure gauge reading at Breather Valve (mmwc)	Vent pressure gauge reading at Breather Valve (mmwc)
0 mmwc	0 mmwc
100 mmwc	0 mmwc
150 mmwc	0 mmwc
200 mmwc	0 mmwc
250 mmwc	0 mmwc
300 mmwc	0 mmwc
350 mmwc	250 mmwc

Remarks (If Any)

OK

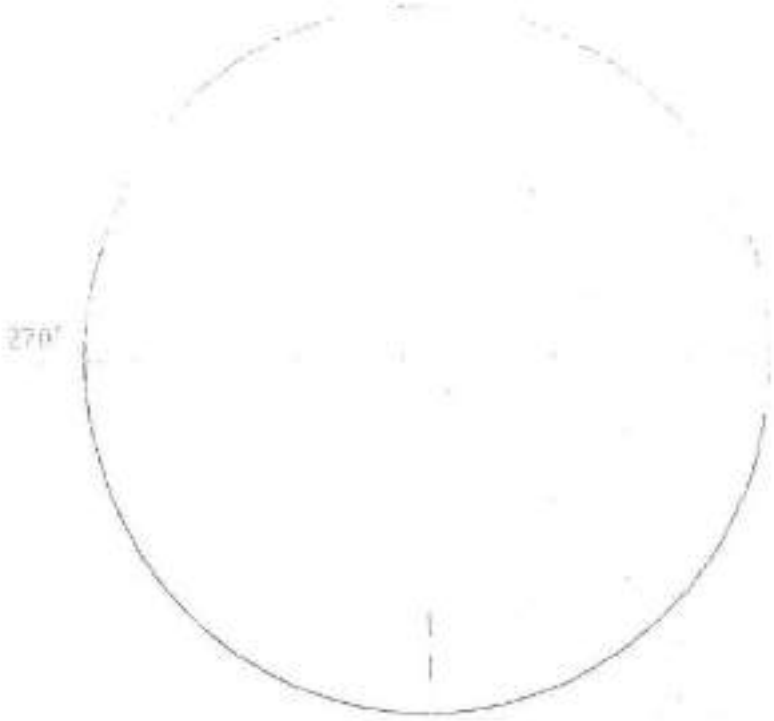
DISCRIPTION	WORK DONE BY	CHECKED BY
Name	Manjit Singh	Jatin Patel
Signature	Manjit	

Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	27	11

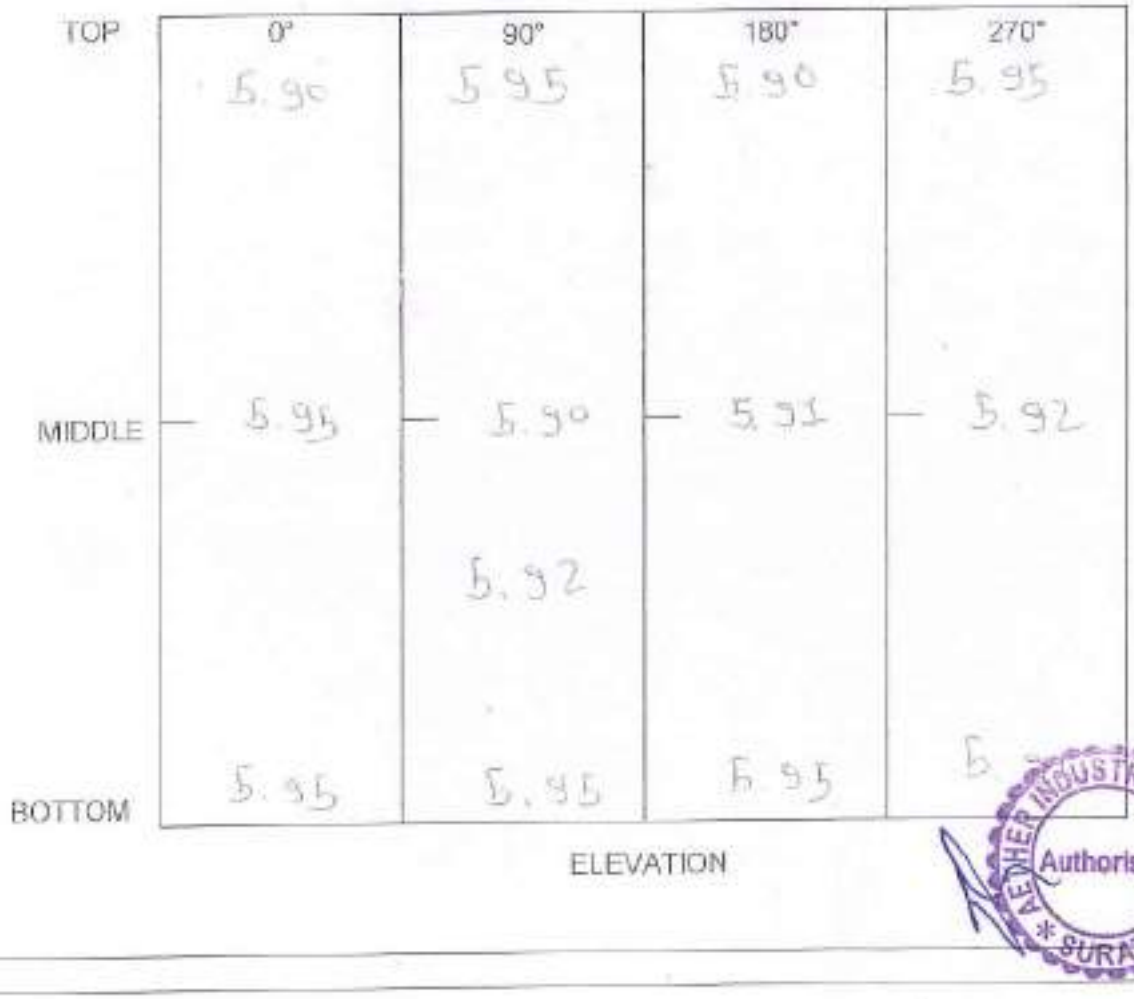
11

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2086



PLAN



ELEVATION

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Node	Stream	Sr. No.	Page Ref. No
Node 2	Stream-1	35	12
Node 10	Stream-1	177	
Node 12	Stream-1	215	

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Node	Stream	Sr. No.	Page Ref. No
Node 2	Stream-1	39	13
Node 4	Stream-1	50	
		54	
Node 5	Stream-1	78	
Node 6	Stream-1	89	
		94	
Node 7	Stream-1	116	
Node 10	Stream-1	182	
	Stream-3	192	
Node 13	Stream-1	231	
Node 15	Stream -1	270	

13



SR. NO.	PLANT NAME	TAG NO.	SERVICE	CONTROL VALVE OPENING STATUS FROM DCS				DATE	DONE BY	CHECK BY	REMARKS

2090



Node	Stream	Sr. No.	Page Ref. No
Node 2	Stream-1	41	14
Node 11	Stream-1	207	
Node 12	Stream-1	219	

14

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Node	Stream	Sr. No.	Page Ref. No
Node 2	Stream-1	42	15
Node 4	Stream-1	57	
Node 5	Stream-1	79	
Node 6	Stream-1	98	
Node 7	Stream-1	117	
Node 10	Stream-1	184	
	Stream-3	196	
Node 13	Stream-1	232	
Node 15	Stream -1	271	

15





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Node	Stream	Sr. No.	Page Ref. No
Node 4	Stream-1	53	16

16



2096

ISSUED BY
Sign. & Date: 12/01/2023
QA Department

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PREVENTIVE MAINTENANCE OF STAINLESS STEEL (SS) REACTOR (QUARTERLY)

PREVENTIVE MAINTENANCE CHECKLIST STAINLESS STEEL REACTOR		Date : 12/01/2023 Equipment ID No : 043 RT-122 Block : IN1-05	
S.No.	Description	Remarks	Performed by
1	Check visually alignment of motor and gearbox	Alignment Checked Found ok	Ajay
2	Check visually alignment of gearbox and stirrer of reactor	OK	Ajay
3	Open the steam trap and Clean it	Steam trap cleaned ok	Ajay
4	Check for any abnormal noise and vibrations in Reactor.	OK	Ajay
5	Check oil level in the gearbox	OK	Ajay
6	Check spider/belt condition	N/A	Ajay
7	Check the coupling bush of gearbox and stirrer	OK	Ajay
8	Check all nuts and bolts for tightness	All nut bolt tighting	Ajay
9	Lubricate stirrer stuffing box bearing	OK	Ajay
10	Lubricate variable speed drive	OK	Ajay
11	Check the mechanical seal leakage	Checked Found OK	Ajay
12	Check thermo-syphon oil pressure as per requirement	OK	Ajay
13	Check thermo-syphon oil level	Checked Found OK	Ajay
14	Check & clean reactor's gasket (If needed then replace it)		

Checked by : 12/01/2023

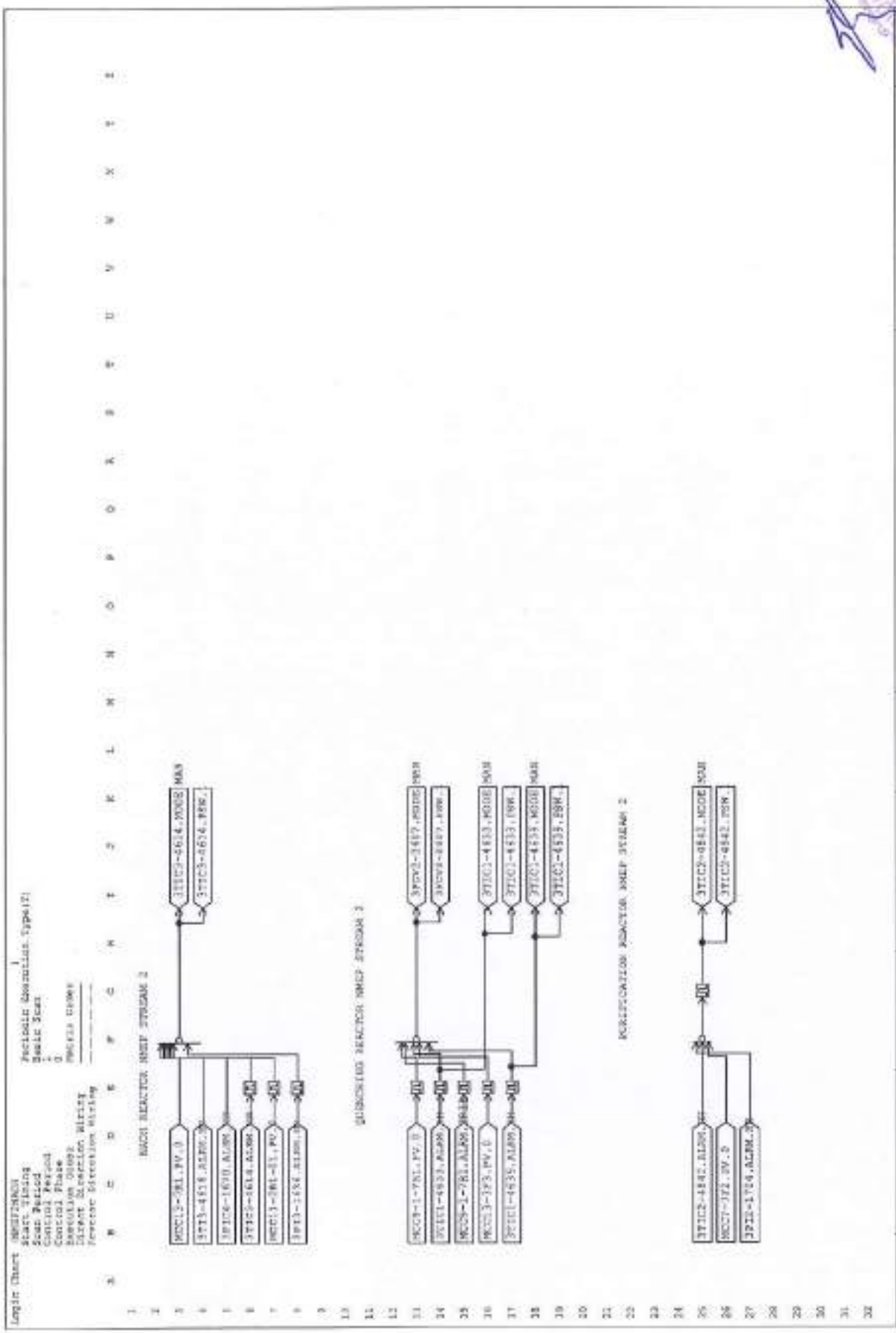
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AETHER INDUSTRIES LTD * QA QC

Node	Stream	Sr. No.	Page Ref. No
Node 5	Stream-1	70	17
		71	
		72	
		74	
		75	
		76	
		86	
Node 15	Stream -1	262	
		263	
		264	
		266	
		267	
		268	

17

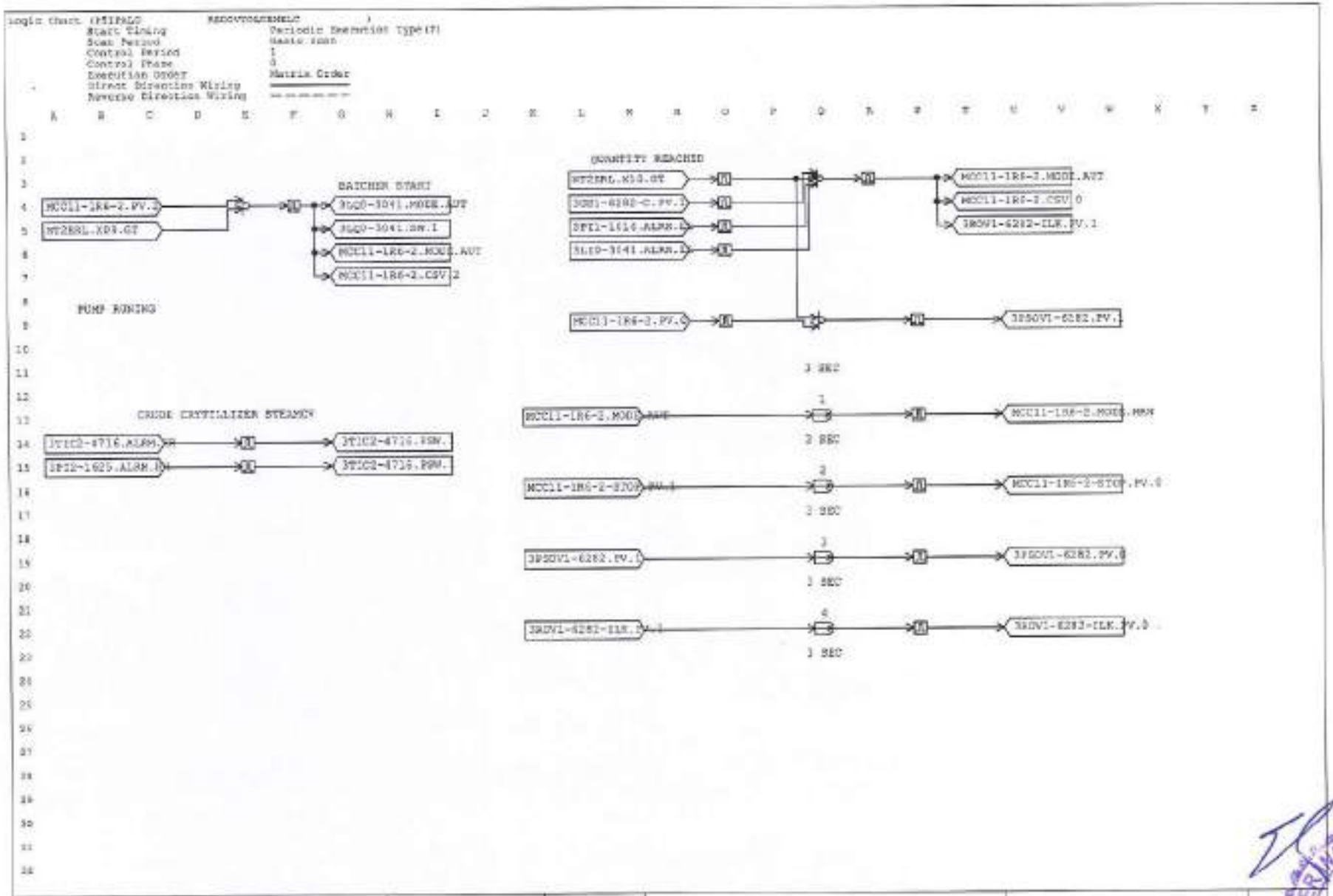
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Logic Chart
Start Timing
Scan Period
Control Period
Control Phase
Execution Order
Start Execution Timing
Precise Execution Timing
Periodic Execution Type(F)
Basic Scan
PROCESS TAGS
MAIN REACTOR RMSP STREAM 2
QUENCHING REACTOR RMSP STREAM 2
PURIFICATION REACTOR RMSP STREAM 2
PROJECT:
STATION:
SECTION:
FILE NAME:
SAVED DATE:
PRINTED DATE:
RMSP2MAIN.edf
12/19/2023 10:13:38 PM
12/20/2023
COMMENT:
DRAWER:
YOKOGAWA
PAGE:

Node	Stream	Sr. No.	Page Ref. No
Node 6	Stream-1	92	18
		96	
		97	
		107	
Node 15	Stream -1	278	

18

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PROJECT:	AILINT	FILE NAME:	PSIPALC.wdf	SHEET:		YOKOGAWA	PAGE:
STATION:	FCS0103	SAVED DATE:	12/19/2022 9:57:03 PM	COMMENT:	RECOVTOLUSMELC		
SECTION:		PRINTED DATE:	12/20/2022	DRAWER:			

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2100

Node	Stream	Sr. No.	Page Ref. No
Node 6	Stream-1	93	19

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Data : Equipment TAG No : Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performe by
1	Check All nuts and bolts for tightness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		RAMESH
4	Visually check Gasket condition	checked	✓		RAMESH

Note:-

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No
Node 6	Stream-1	99	20

20

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ISSUED BY
Sign. & Date: 30/09/2019
QA Department

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PREVENTIVE MAINTENANCE OF STAINLESS STEEL (SS) REACTOR (QUARTERLY)

PREVENTIVE MAINTENANCE CHECKLIST STAINLESS STEEL REACTOR		Date : 08/1/2023 Equipment ID No : 042 RT 093 Block : INT-04	
S.No.	Description	Remarks	Performed by
1	Check visually alignment of motor and gearbox	Alignment checked ok	Sameshwar
2	Check visually alignment of gearbox and stirrer of reactor	Found ok	Sameshwar
3	Open the steam trap and Clean it	Steam trap cleaned	Sameshwar
4	Check for any abnormal noise and vibrations in Reactor.	Checked, OK	Sameshwar
5	Check oil level in the gearbox	oil checked ok	Sameshwar
6	Check spider/belt condition	N/A	Sameshwar
7	Check the coupling bush of gearbox and stirrer	Checked ok	Sameshwar
8	Check all nuts and bolts for tightness	All nut bolt Tighting	Sameshwar
9	Lubricate stirrer stuffing box bearing	OK	Sameshwar
10	Lubricate variable speed drive	OK	Sameshwar
11	Check the mechanical seal leakage	No leakage. ok	Sameshwar
12	Check thermo-syphon oil pressure as per requirement	Checked ok	Sameshwar
13	Check thermo-syphon oil level	Checked Found ok	Sameshwar
14	Check & clean reactor's gasket (If needed then replace it)		

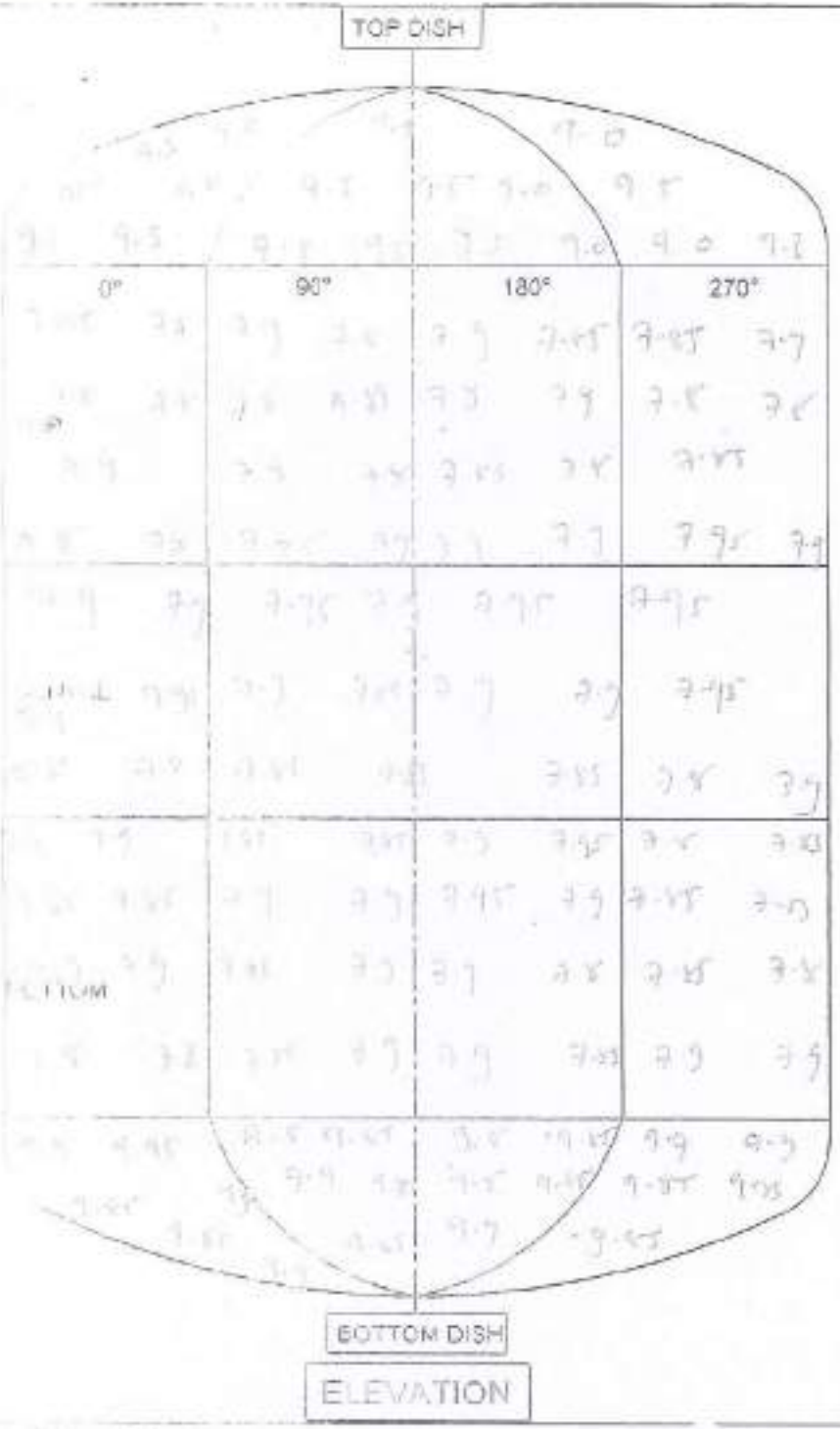
Checked by : 08/1/2023

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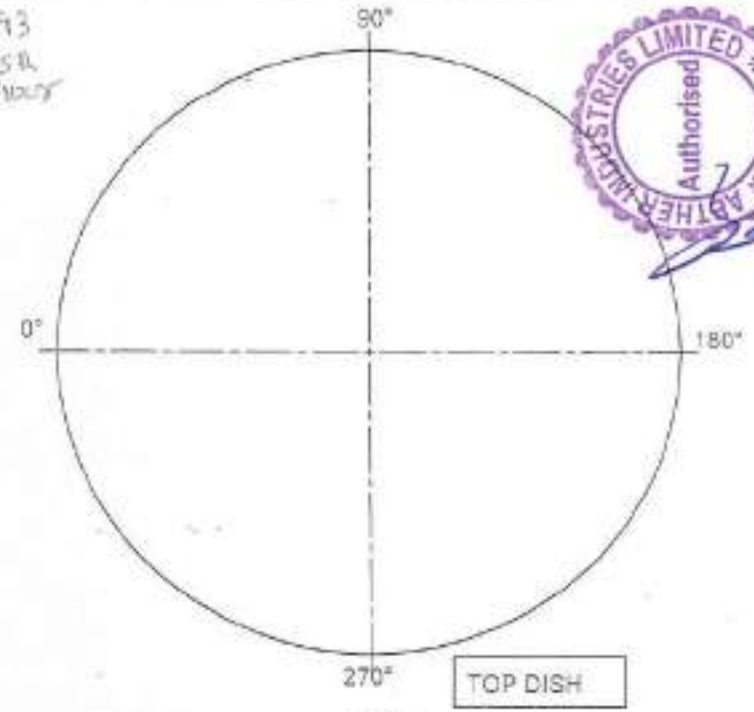
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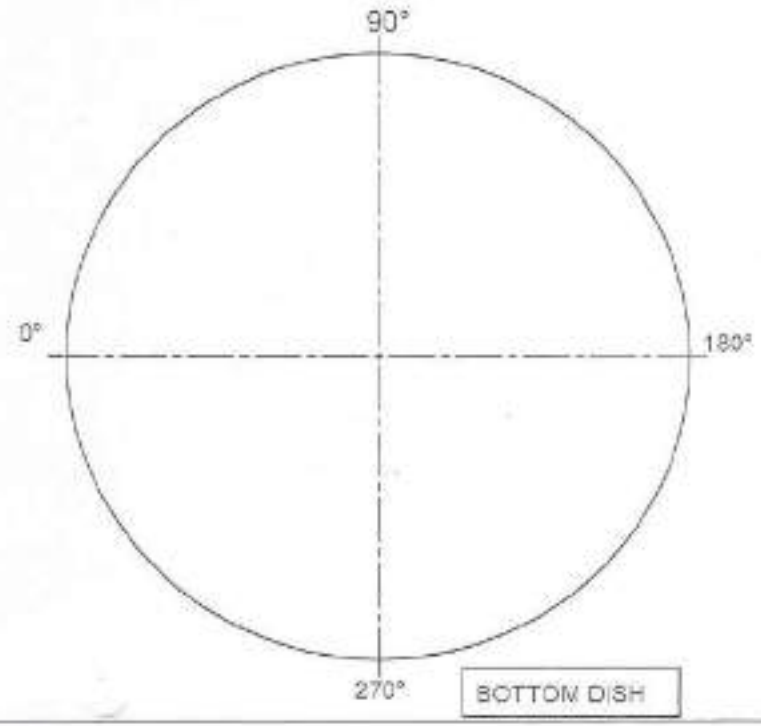
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EQUIP.NO.: 042 RT - 093
EQUIP.NAME. 12 KL SS R
LOCATION: second floor



ELEVATION





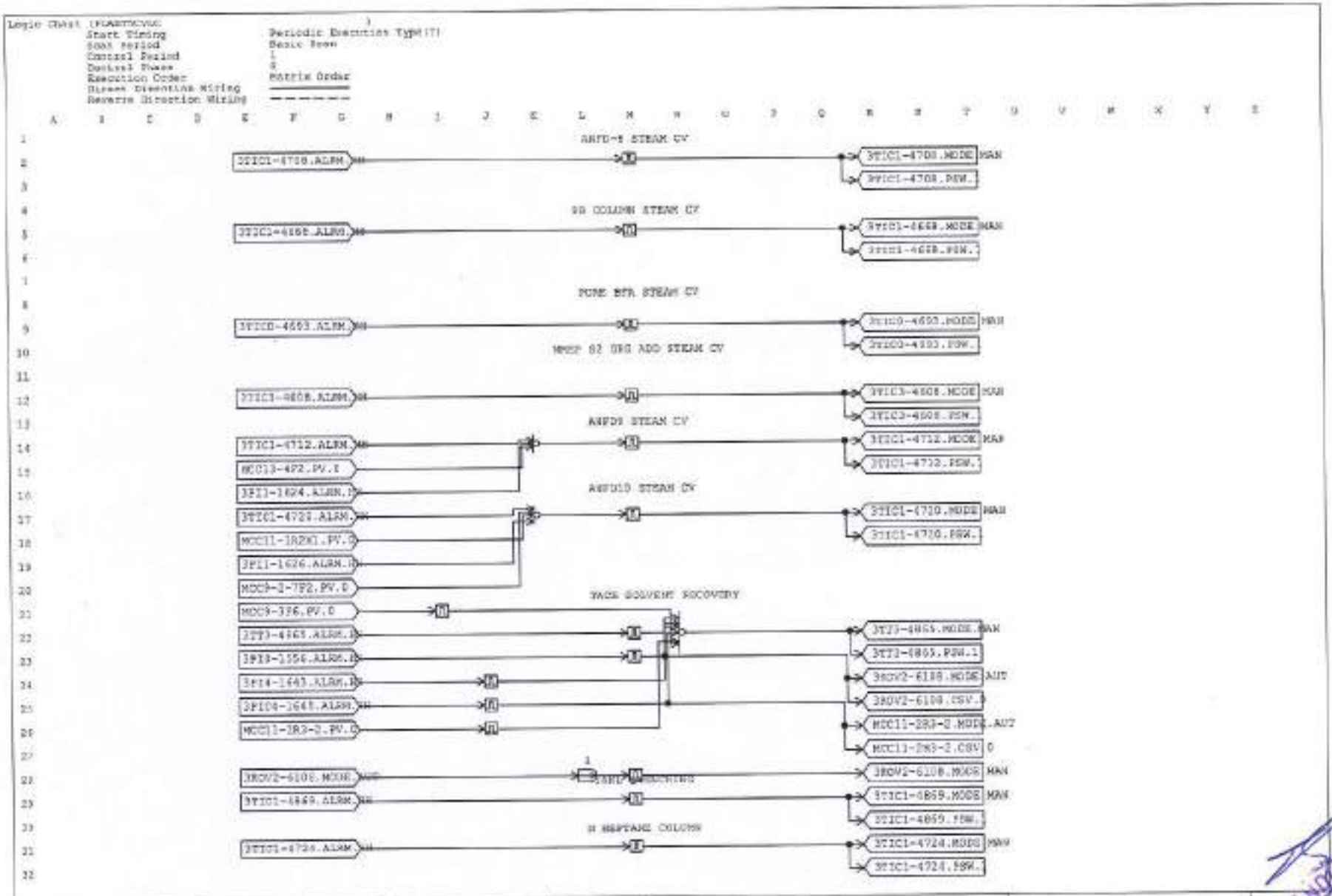
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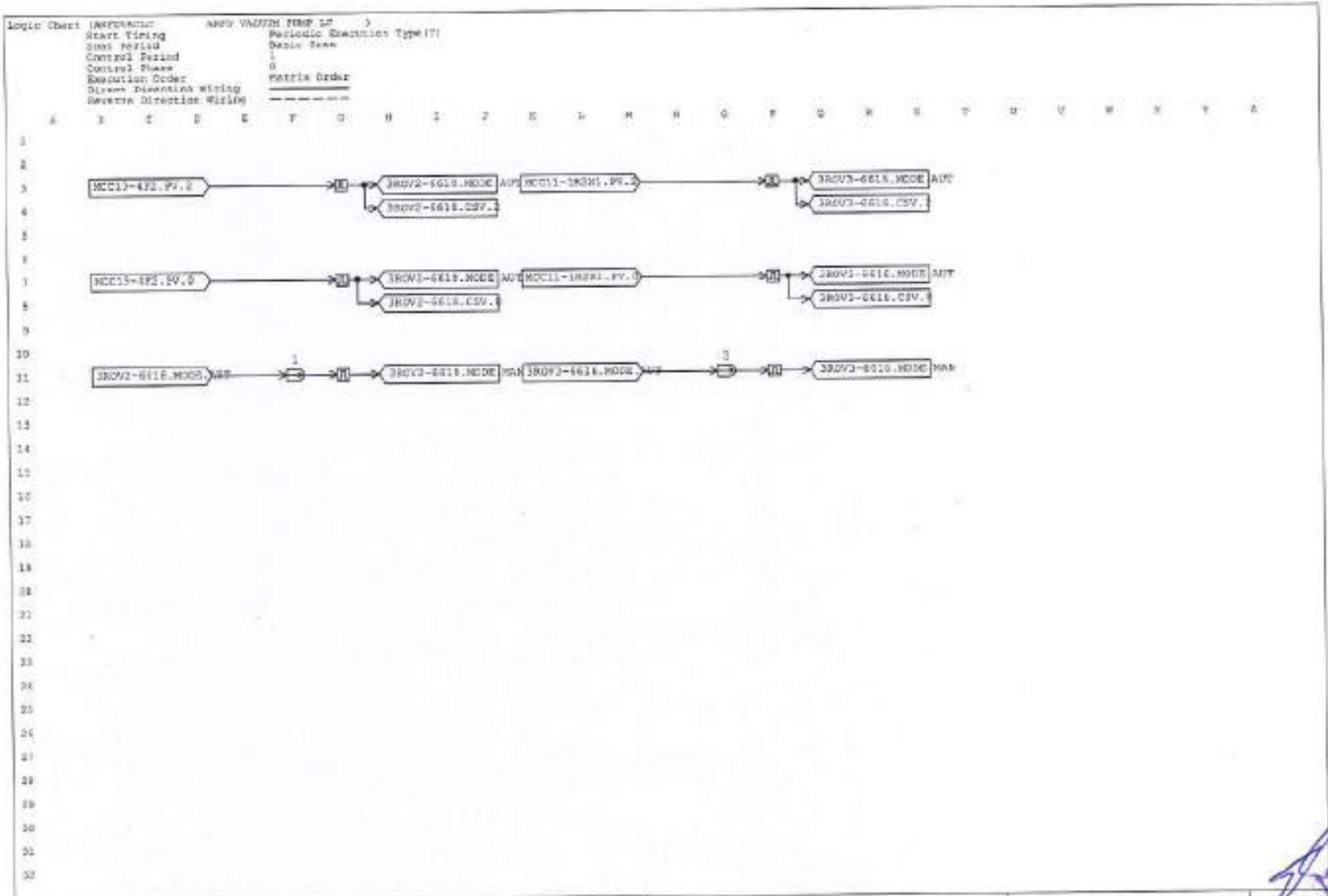
Node	Stream	Sr. No.	Page Ref. No
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		110	
		112	
		113	
		114	
Node 13	Stream-1	223	
		224	
		227	
		228	
		229	

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SECTION:		PRINTED DATE:	12/20/2023	DRAWER:			

2109

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Node	Stream	Sr. No.	Page Ref. No
Node 7	Stream-1	122	23
Node 13	Stream-1	237	

23



Logic Chart (ANFDVACLC ANFD VACUUM PUMP LC 1

Scan Timing: Periodic Execution Type(T)
Scan Period: Basic Scan
Control Period: 1
Control Phase: 0
Execution Order: Matrix Order
Direct Direction Wiring
Reverse Direction Wiring



PROJECT:	AILINT	FILE NAME:	ANFDVACLC.edf	SHEET:	
STATION:	FCS0103	SAVED DATE:	11/23/2021 12:14:27 PM	COMMENT:	ANFD VACUUM PUMP LC
SECTION:		PRINTED DATE:	12/29/2022	DRAWER:	Rajesh

YOKOGAWA

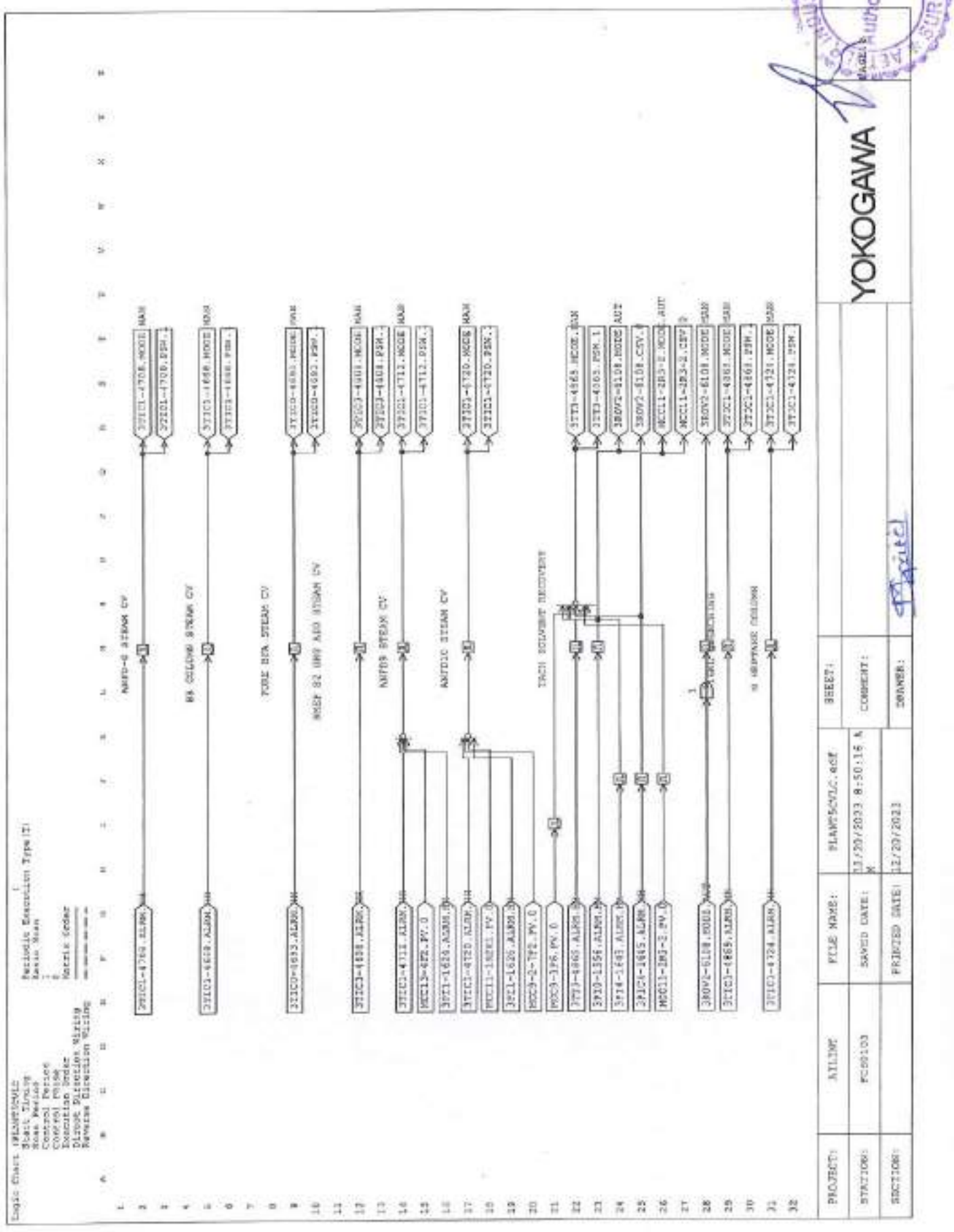
WATER INDUSTRIES LIMITED * Authorised * SURAT *

2111

Node	Stream	Sr. No.	Page Ref. No
Node 8	Stream-1	130	24
		133	
		136	
		141	
		146	
Node 9	Stream-1	159	
		162	

24

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YOKOGAWA
PROJECT:
STATION:
SECTION:
FILE NAME:
SAVED DATE:
PRINTED DATE:
SHEET:
COMMENT:
DRAWER:
Logic Chart (FBD/SFC)
Basic Timing
Step Ladder
Control Phase
Control Loop
Execution Order
Block Execution Wiring
Reverse Direction Wiring
Periodic Execution Type (T)
Basic Unit
Basic Unit
Remote Coder
NAPTA STEAM CV
BS CRUDE STEAM CV
FUEL GAS STEAM CV
NAPTA STEAM CV
KAPTA STEAM CV
ANTOIC STEAM CV
TAIL SCRUBBER RECOVERY

Node	Stream	Sr. No.	Page Ref. No
Node 8	Stream-1	131	25
		142	
		147	

25

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 16/12/2023 Equipment TAG No : CAU-51-137 Block : UNIT-05			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleaned	✓		RAMESH
4	Visually check Gasket condition	checked	✓		RAMESH
Note:-					

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No
Node 8	Stream-1	143	26
		148	
		150	

26



BREATHER VALVE CALIBRATION RECORD SHEET (PSW 01)

Breather Valve I.D. number	
Calibration Date	
Calibration Due Date	

Sr No.	Check Point	Mark (√) where applicable
1	Check physical condition of breather valve?	
2	Check leakage test of breather valve?	
3	Compare pressure/vacuum reading at inlet and vent of breather valve (Acceptance Limit : +/- 10% of full scale)	

Inlet pressure gauge reading at Breather Valve (mmwc)	Vent pressure gauge reading at Breather Valve (mmwc)
0	0
100	0
150	0
200	0
250	0
300	0
350	350

Remarks (If Any)

ok

DISCRIPTION	WORK DONE BY	CHECKED BY
Name	Sumit Paramar	Yashu Patel
Signature	Sumit	Yashu

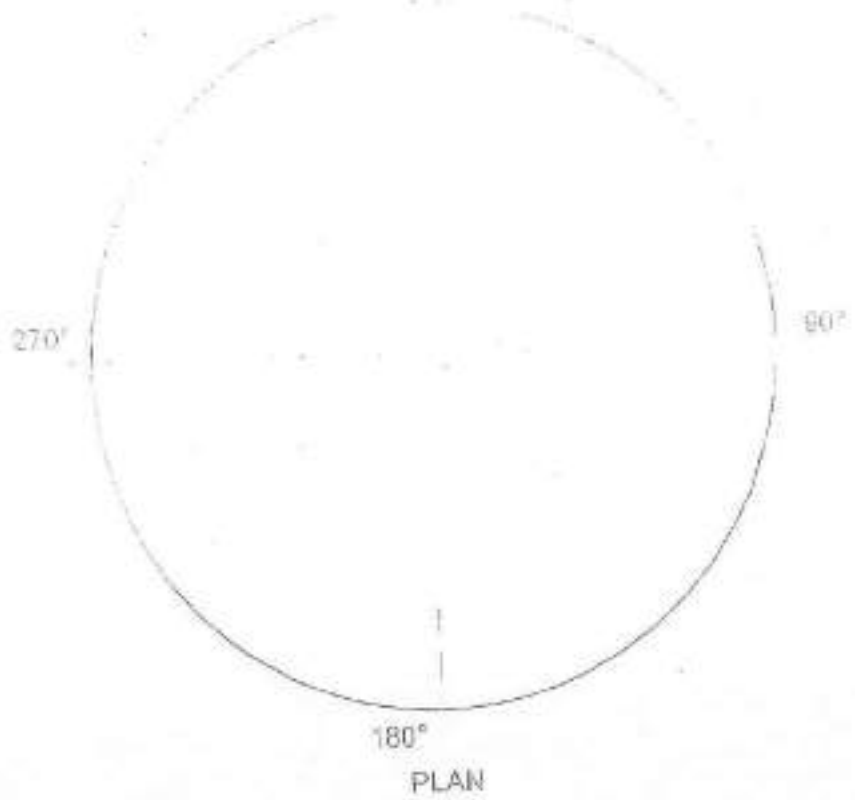
CHEF INDUSTRIES

Node	Stream	Sr. No.	Page Ref. No
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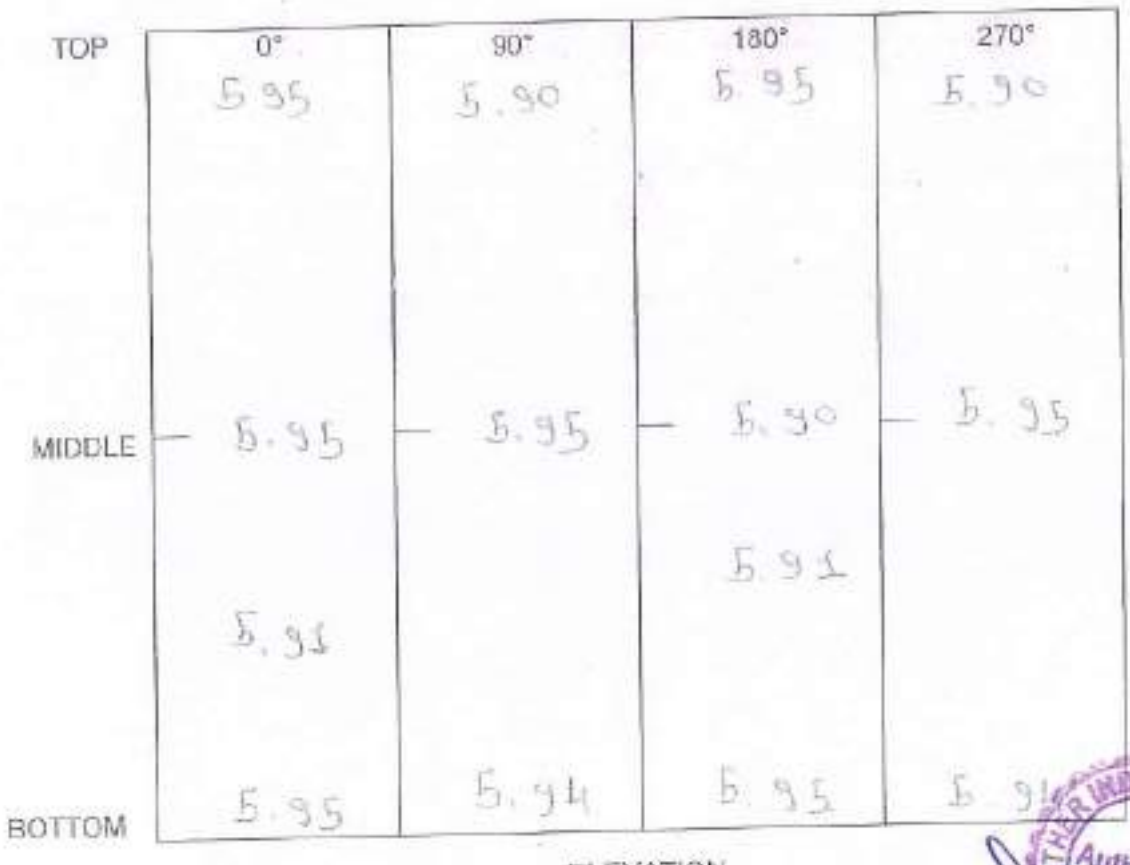
27



2119



PLAN



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Node	Stream	Sr. No.	Page Ref. No
Node 9	Stream-1	158	28
		166	
		168	

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : Equipment TAG No : Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performe by
1	Check All nuts and bolts for tightness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		RAMESH
4	Visually check Gasket condition	Checked	✓		RAMESH

Note:-

Checked by MD

10/12/2023

Checked By PD

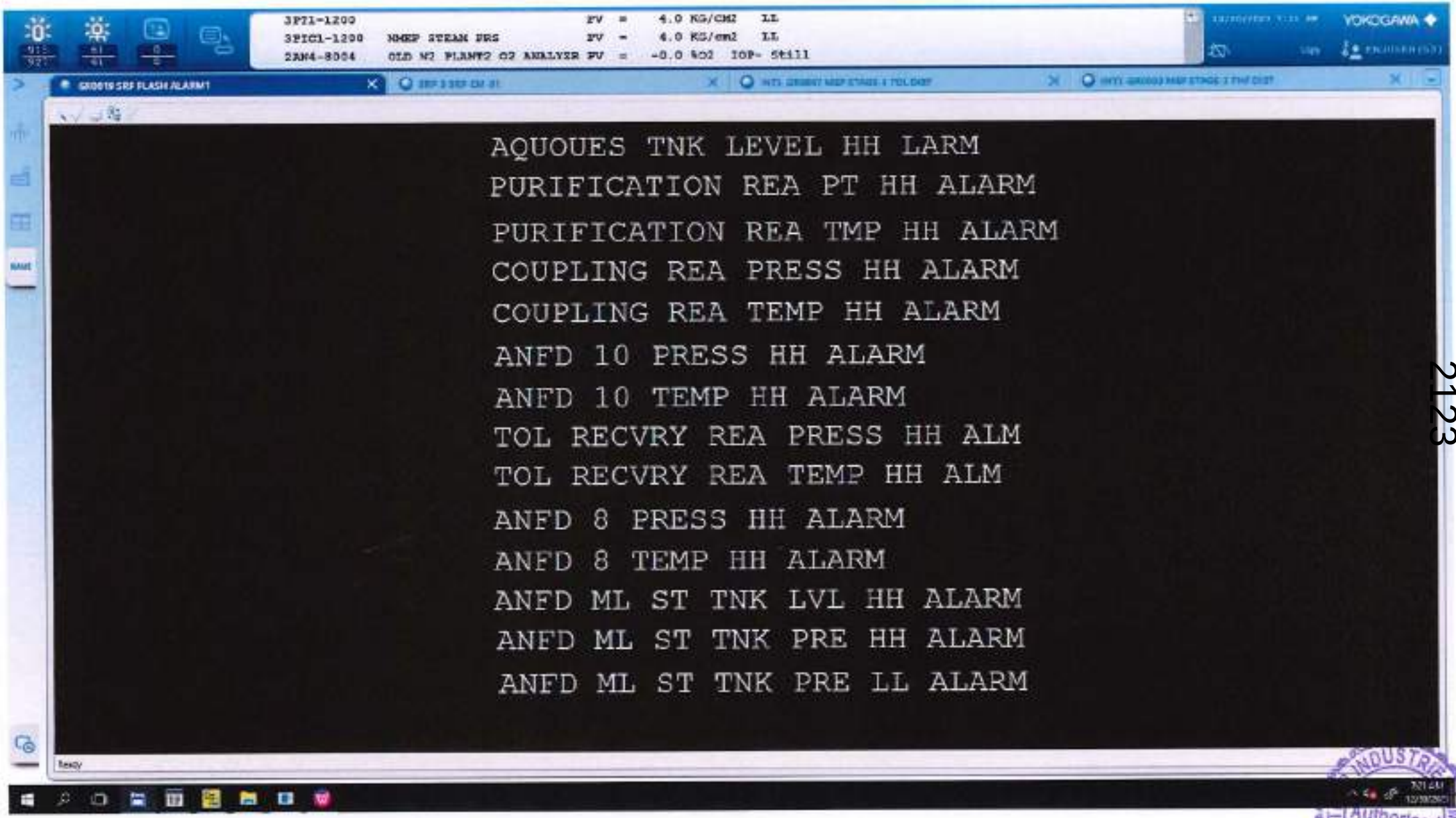
10/12/2023

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Node	Stream	Sr. No.	Page Ref. No
Node 9	Stream-1	161	29
		164	
Node 10	Stream-1	180	
		183	
	Stream-3	188	
	Stream-3	193	
Node 11	Stream-1	206	
		208	
Node 12	Stream-1	217	
		220	
Node 13	Stream-1	225	
		226	
		230	
Node 14	Stream-1	241	
		244	
		246	
		248	
		252	
Node 15	Stream -1	265	
		269	

29

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2123

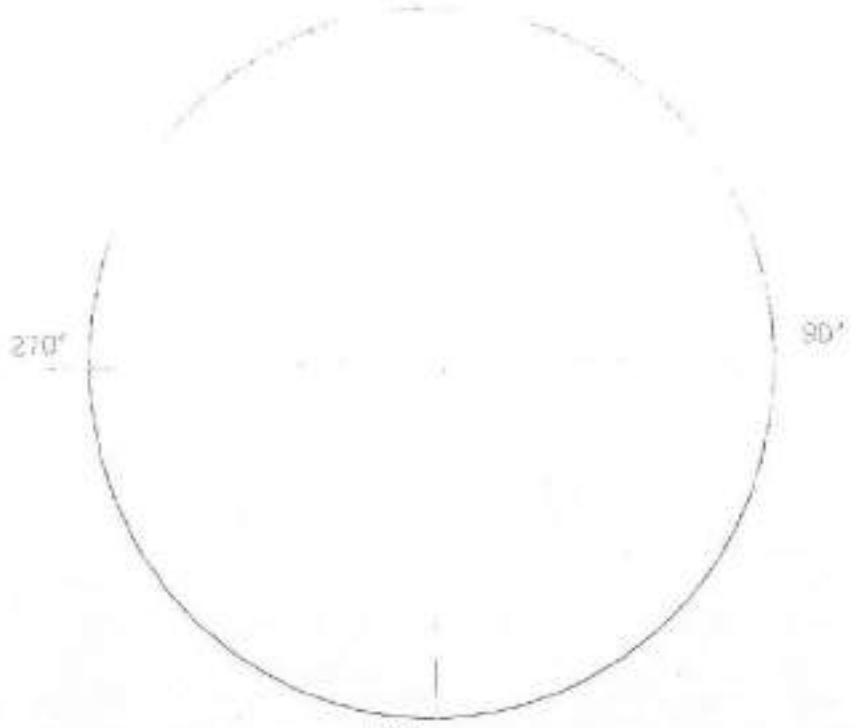
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SURAT

Node	Stream	Sr. No.	Page Ref. No
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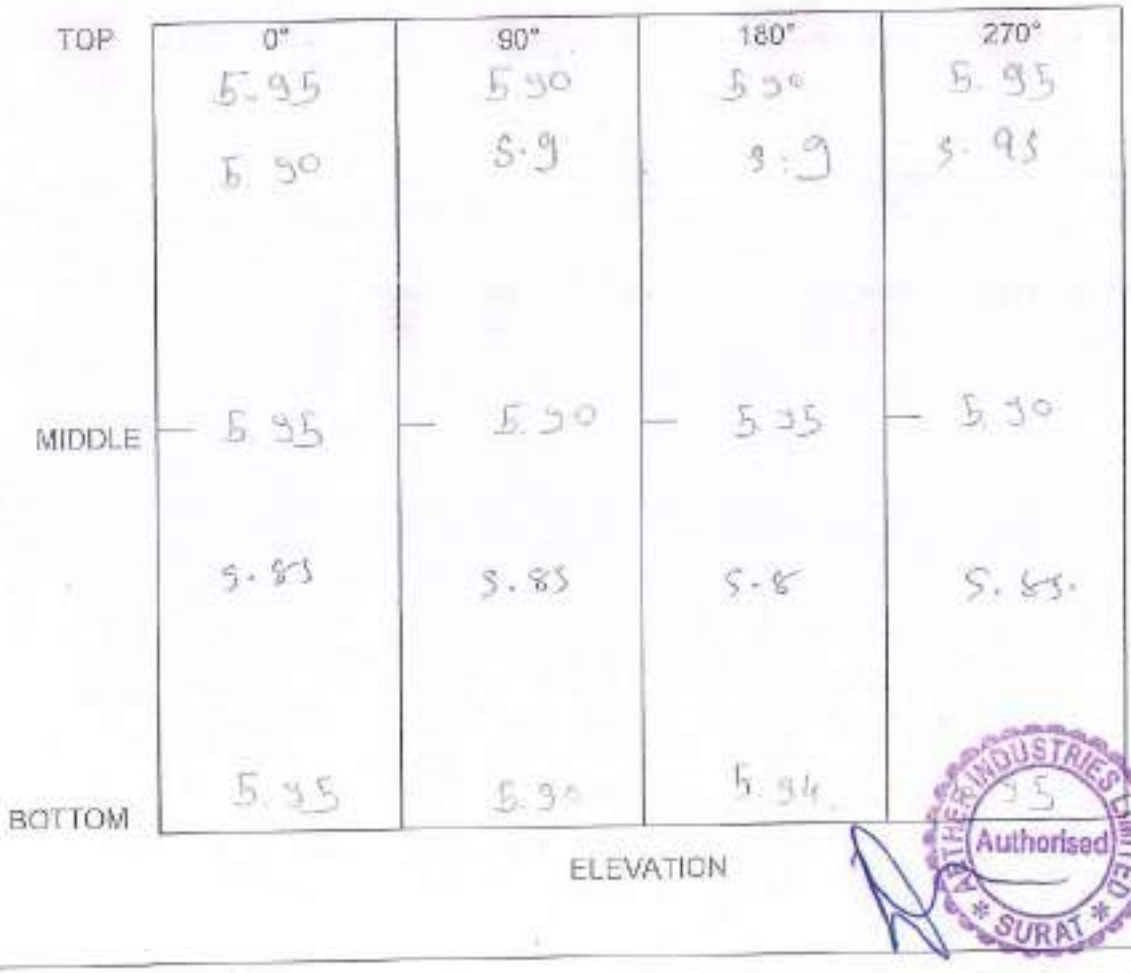
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2125



PLAN

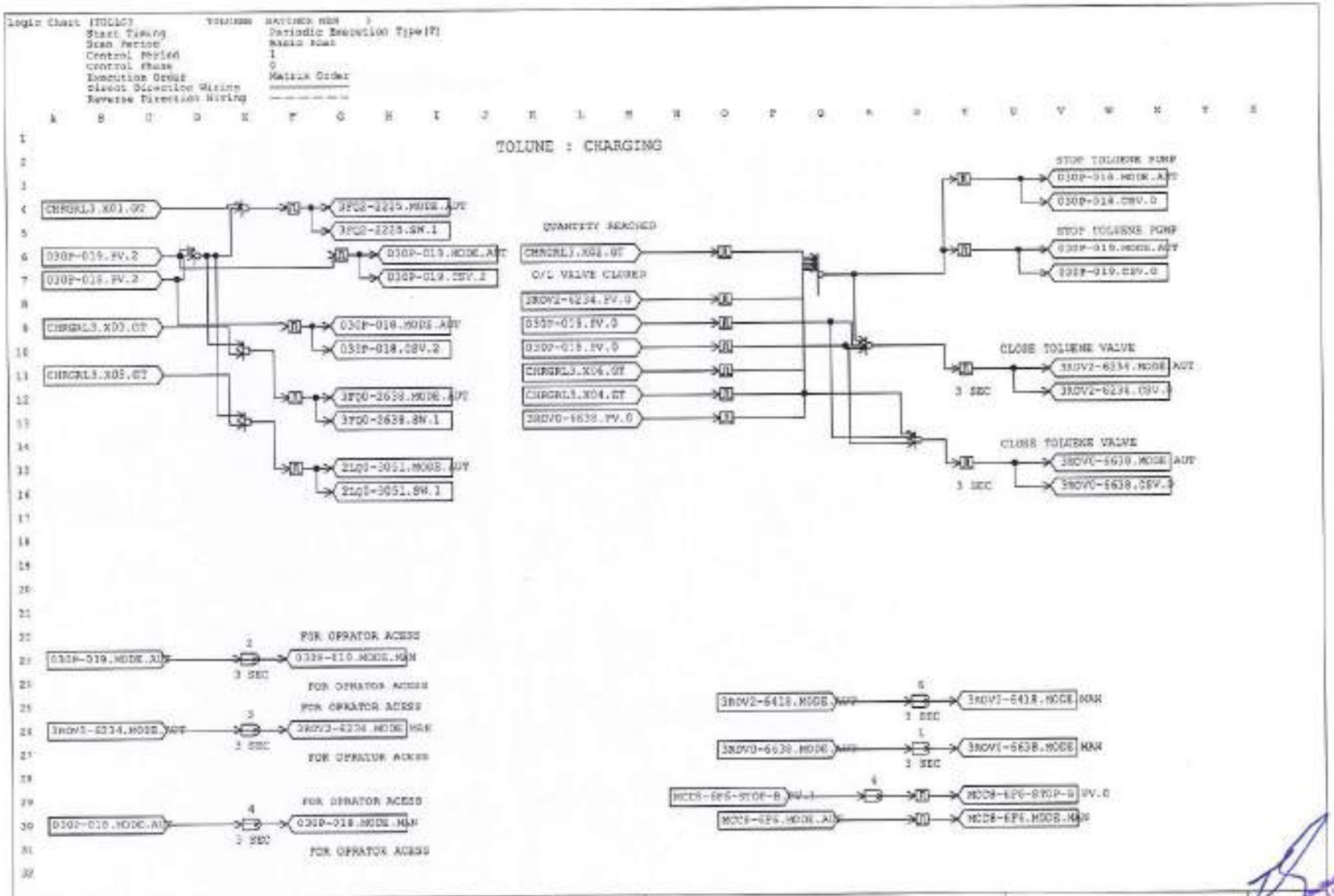


ELEVATION

Node	Stream	Sr. No.	Page Ref. No
Node 10	Stream-1	178	31
		179	
		186	

31





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Node	Stream	Sr. No.	Page Ref. No
Node 10	Stream-1	181	32
	Stream-3	191	

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : [illegible] Equipment TAG No : [illegible] Block : [illegible]			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	Ok	✓		JAJMJN
2	Check visual condition of flame element	Ok	✓		JAJMJN
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		JAJMJN
4	Visually check Gasket condition	checked	✓		JAJMJN
Note:-					

Checked by MD

Hardik
10/12/2013

Checked By PD

Amit
10/12/2013

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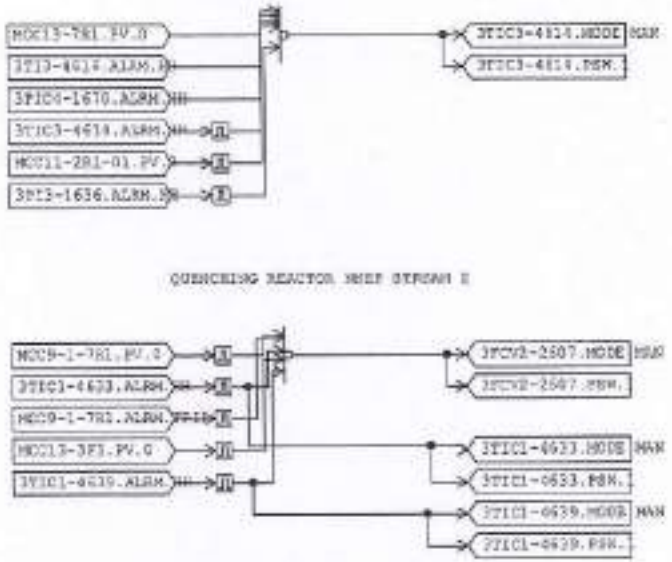
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Node 10	Stream-3	190	33
		194	
		195	
		205	
Node 12	Stream-1	216	

33

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Logic Chart: INHEP2NAOH

Start Timing	Periodic Execution Type(T)
Scan Period	Basic Scan
Control Period	1
Control Phase	0
Execution Order	Matrix Order
Direct Direction Wiring	————
Reverse Direction Wiring	————



PROJECT:	ATLINT	FILE NAME:	NHEP2NAOH.sdl	SHEET:		YOKOGAWA
STATION:	FC60103	SAVED DATE:	12/19/2023 10:13:38 AM	COMMENT:		
SECTION:		PRINTED DATE:	12/20/2023	DRAWER:		

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Node	Stream	Sr. No.	Page Ref. No
Node 10	Stream-3	197	34

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ISSUED BY
Sign. & Date: 30/09/2023
QA Department

MASTER COPY

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PREVENTIVE MAINTENANCE OF STAINLESS STEEL (SS) REACTOR (QUARTERLY)

PREVENTIVE MAINTENANCE CHECKLIST STAINLESS STEEL REACTOR		Date : 24/12/2023 Equipment ID No : 042RT-087 Block : Int-04	
S.No.	Description	Remarks	Performed by
1	Check visually alignment of motor and gearbox	Alignment Checked ok	Ajay
2	Check visually alignment of gearbox and stirrer of reactor	Checked found ok	Ajay
3	Open the steam trap and Clean it	Steam trap cleaned	Ajay
4	Check for any abnormal noise and vibrations in Reactor.	No noise found	Ajay
5	Check oil level in the gearbox	oil Change	Ajay
6	Check spider/belt condition	N/A	Ajay
7	Check the coupling bush of gearbox and stirrer	Checked ok	Ajay
8	Check all nuts and bolts for tightness	All nut bolt tighting	Ajay
9	Lubricate stirrer stuffing box bearing	ok	Ajay
10	Lubricate variable speed drive	ok	Ajay
11	Check the mechanical seal leakage	No leakage, ok	Ajay
12	Check thermo-syphon oil pressure as per requirement	Checked ok	Ajay
13	Check thermo-syphon oil level	checked ok	Ajay
14	Check & clean reactor's gasket (If needed then replace it)		

Checked by : 24/12/2023

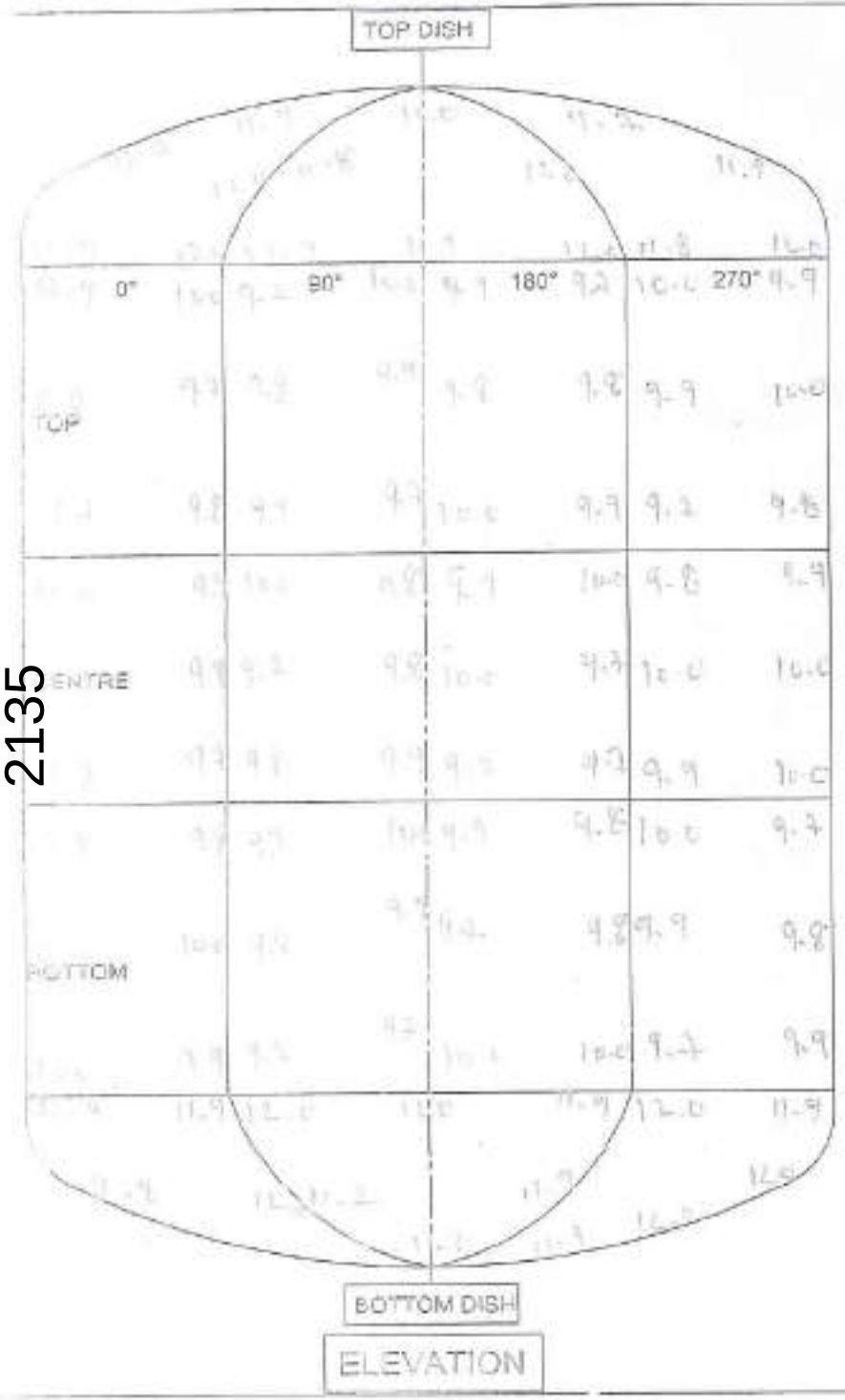
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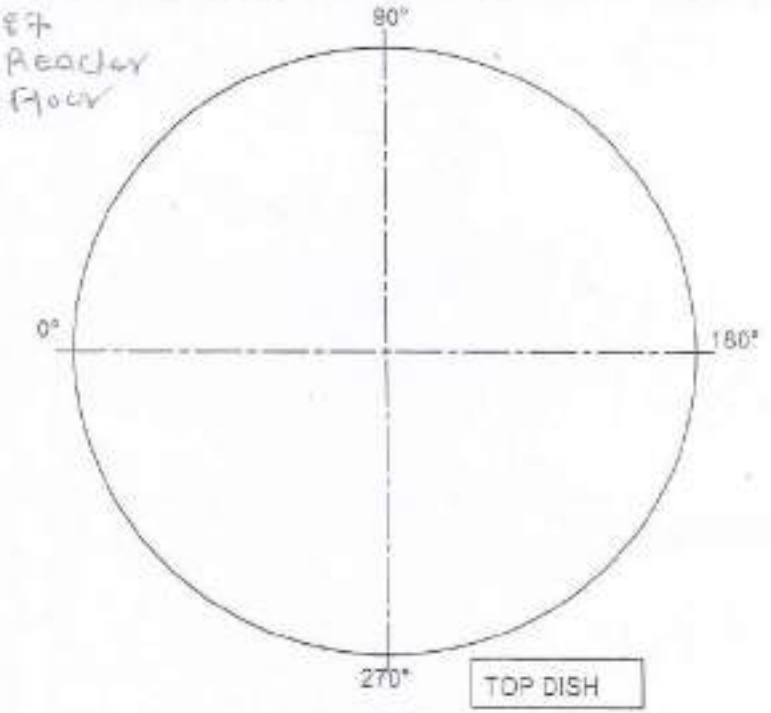
35

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2135

EQUIP.NO.: 642 P7 557
EQUIP.NAME: 12 KL Reactor
LOCATION: Second Floor









Node	Stream	Sr. No.	Page Ref. No
Node 12	Stream-1	218	36

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : Equipment TAG No : Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleaned	✓		RAMESH
4	Visually check Gasket condition	Checked	✓		RAMESH
Note:-					

Checked by MD

10/12/2023

Checked By PD

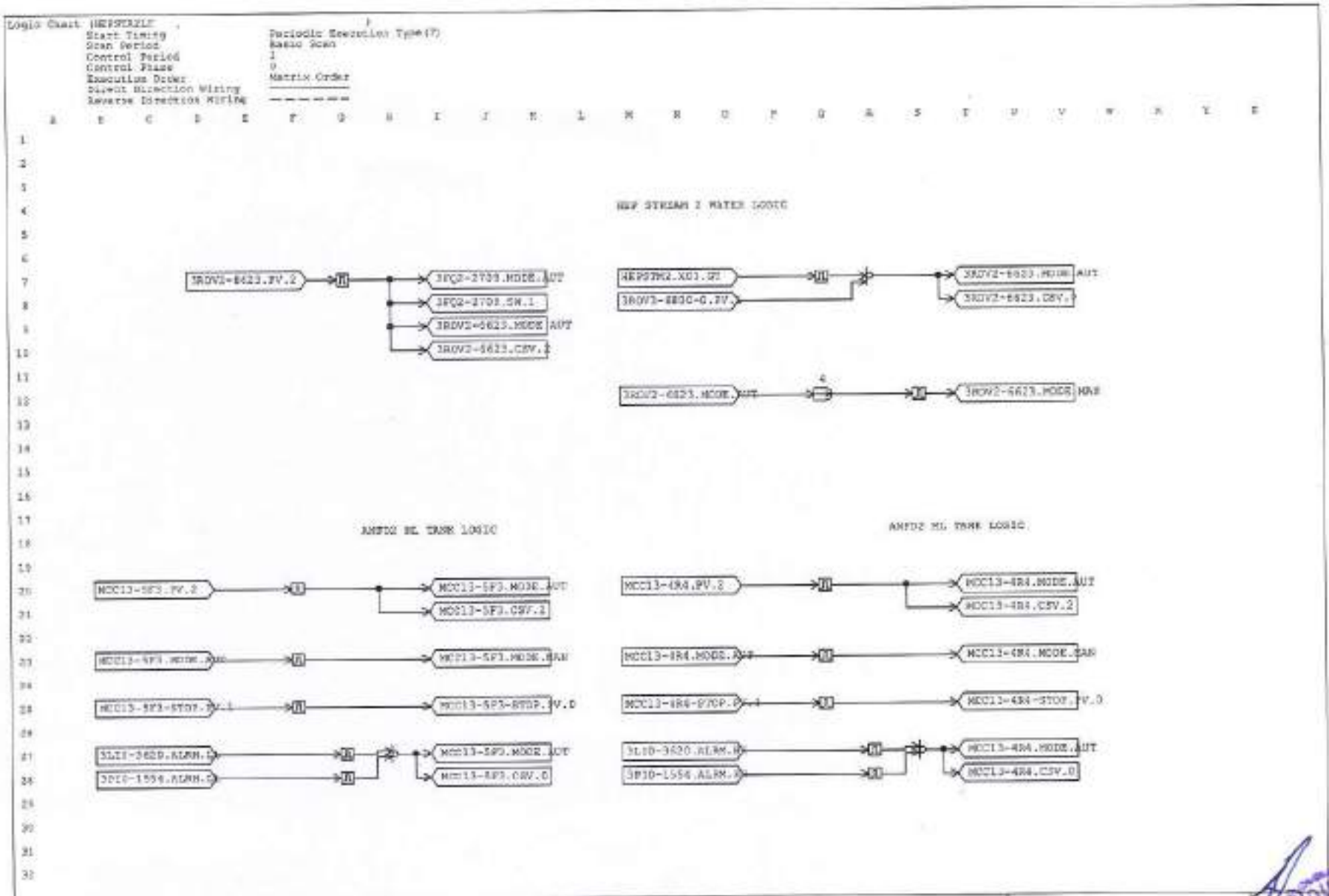
10/12/2023

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Node	Stream	Sr. No.	Page Ref. No
Node 14	Stream-1	249	37

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Logic Chart 1(HEPSTR2LC
Start Timing
Scan Period
Control Period
Control Phase
Execution Order
Slowest Direction Wiring
Reverse Direction Wiring
Periodic Execution Type(T)
Basic Scan
1
0
Matrix Order
HEP STREAM 2 WATER LOGIC
3ROV2-6623.PV.2
3FQ2-2709.MODE.AUT
3FQ2-2709.SW.1
3ROV2-6623.MODE
3ROV2-6623.CSV.1
4EP03M2.X01.PT
3ROV3-6830-C.PV
3ROV2-6623.MODE.AUT
3ROV2-6623.CSV.1
3ROV2-6623.MODE.AUT
3ROV2-6623.MODE.MAN
AMPD2 HL TANK LOGIC
MCC13-5F3.PV.2
MCC13-5F3.MODE.AUT
MCC13-5F3.CSV.2
MCC13-5F3.MODE.AUT
MCC13-5F3.MODE.MAN
MCC13-5F3-STOP.PV.1
MCC13-5F3-STOP.PV.0
3LSH-3620.ALRM.0
3P10-1556.ALRM.0
MCC13-5F3.MODE.AUT
MCC13-5F3.CSV.0
AMPD2 HL TANK LOGIC
MCC13-4R4.PV.2
MCC13-4R4.MODE.AUT
MCC13-4R4.CSV.2
MCC13-4R4.MODE.AUT
MCC13-4R4.MODE.MAN
MCC13-4R4-STOP.PV.0
3L10-3620.ALRM.0
3P10-1556.ALRM.0
MCC13-4R4.MODE.AUT
MCC13-4R4.CSV.0
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FILE NAME: HEPSTR2LC.edf
SHEET:
STATION: FCS0103
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COMMENT:
SECTION:
PRINTED DATE: 12/20/2023
DRAWER:
YOKOGAWA
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Node	Stream	Sr. No.	Page Ref. No
Node 14	Stream-1	242	38
		250	
		253	

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : [illegible] Equipment TAG No : [illegible] Block : [illegible]			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		[illegible]
2	Check visual condition of flame element	OK	✓		[illegible]
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		[illegible]
4	Visually check Gasket condition	checked	✓		[illegible]
Note:-					

Checked by MD

Hardik
10/12/2023

Checked By PD

Amit
10/12/2023

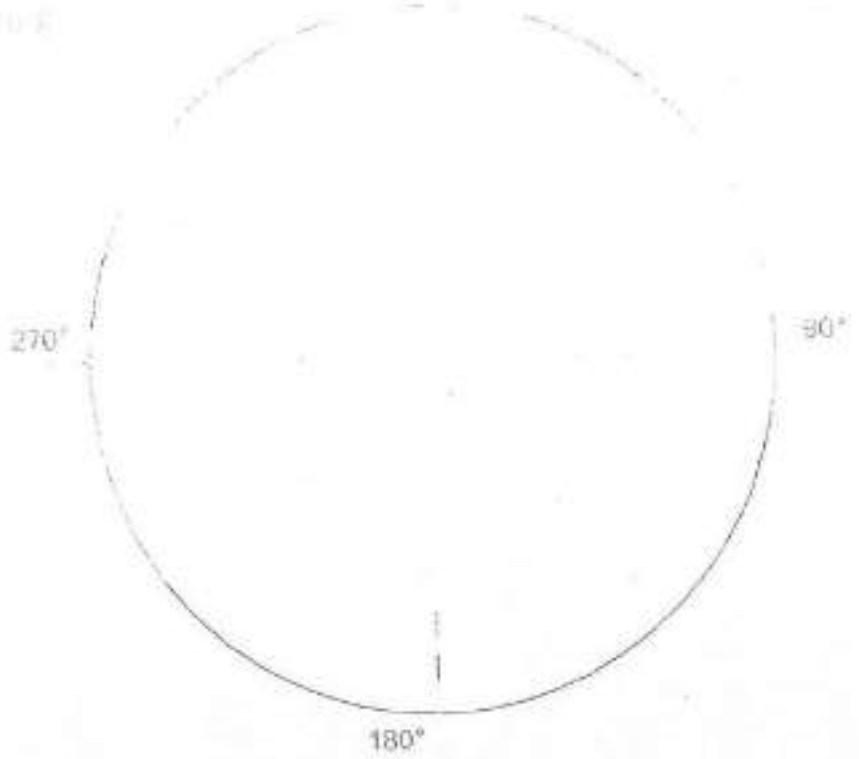
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Node	Stream	Sr. No.	Page Ref. No
Node 14	Stream-1	255	39

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2143



PLAN

	0°	90°	180°	270°
TOP	5.95	5.90	5.90	5.90
	5.95	5.90	5.90	5.85
MIDDLE	5.94	5.90	5.95	5.91
	5.90	5.90	5.91	5.90
BOTTOM	5.93	5.92	5.93	5.

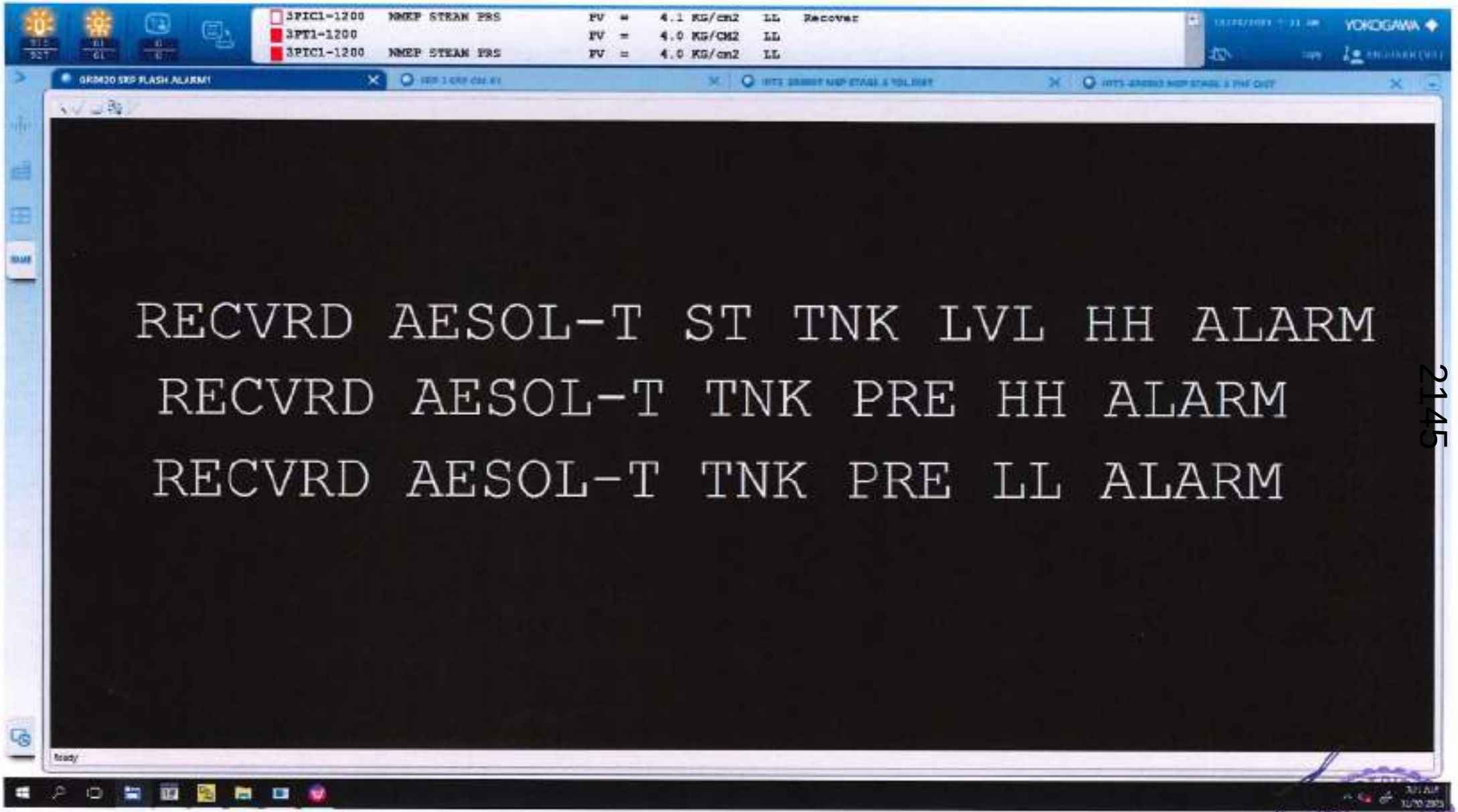
ELEVATION

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Node	Stream	Sr. No.	Page Ref. No
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		286	
		288	
		290	
		295	

40

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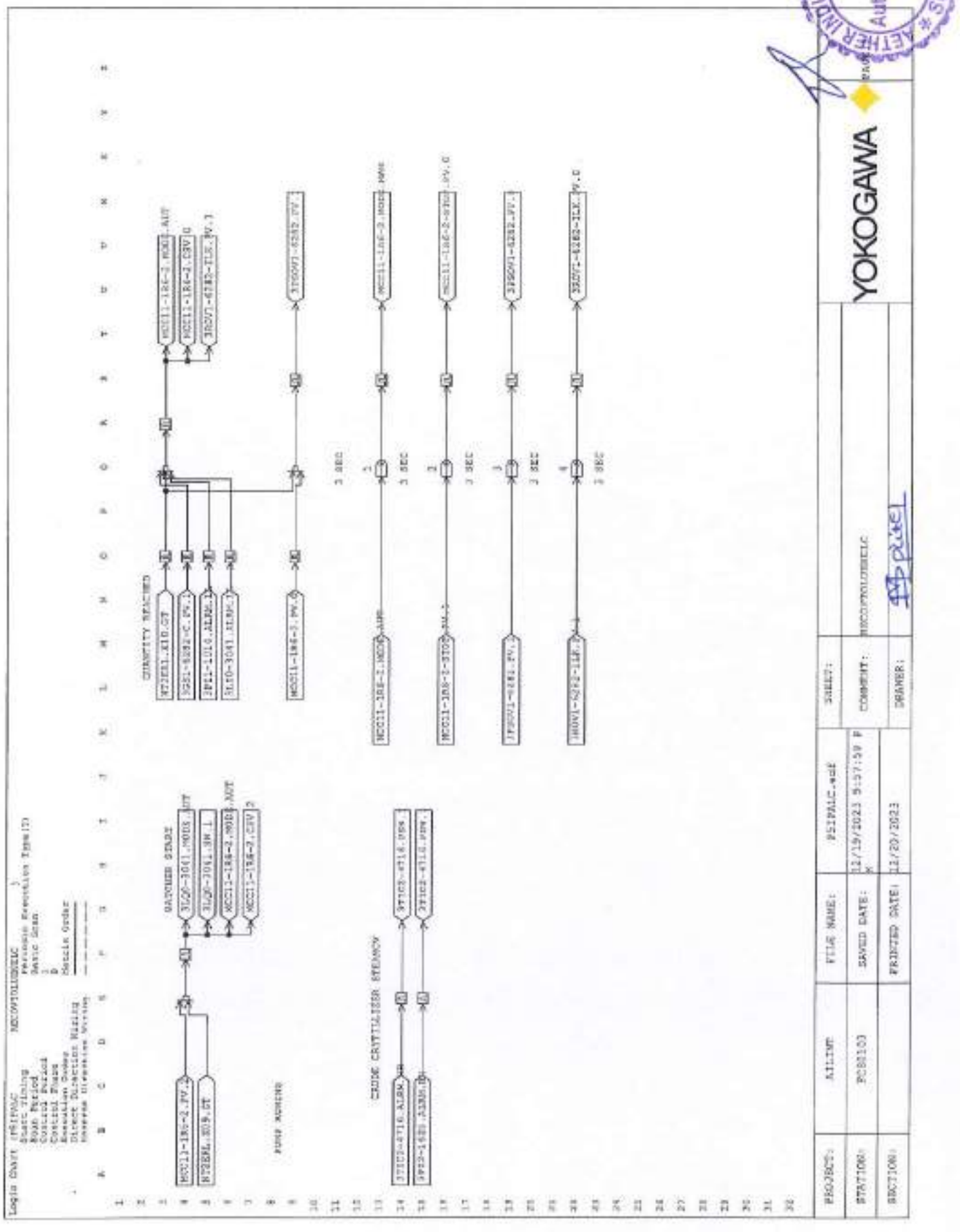
2145

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Node	Stream	Sr. No.	Page Ref. No
Node 16	Stream-1	283 291	41

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Node	Stream	Sr. No.	Page Ref. No
Node 16	Stream-1	284	42
		292	
		296	

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : Equipment TAG No : Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		
2	Check visual condition of flame element	OK	✓		
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		
4	Visually check Gasket condition	checked	✓		

Note:-

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No
Node 16	Stream-1	293 297	43

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BREATHER VALVE CALIBRATION RECORD SHEET (PSM-F02)

Breather Valve I.D. number	AESPL-T Sleeve Tank (BV-03)
Calibration Date	16/12/2022
Calibration Due Date	14/06/2024

Sr. No.	Check Point	Mark off √ / × where applicable
1	Check physical condition of breather valve?	√
2	Check leakage test of breather valve?	√
3	Compare pressure/vacuum reading at inlet and vent of breather valve. (Acceptance Limit : +/- 10% of full scale)	

Inlet pressure gauge reading at Breather Valve (mmwc)	Vent pressure gauge reading at Breather Valve (mmwc)
0 mmwc	0 mmwc
100 mmwc	0 mmwc
150 mmwc	0 mmwc
200 mmwc	0 mmwc
250 mmwc	0 mmwc
300 mmwc	0 mmwc
350 mmwc	350 mmwc

Remarks (If Any) ok

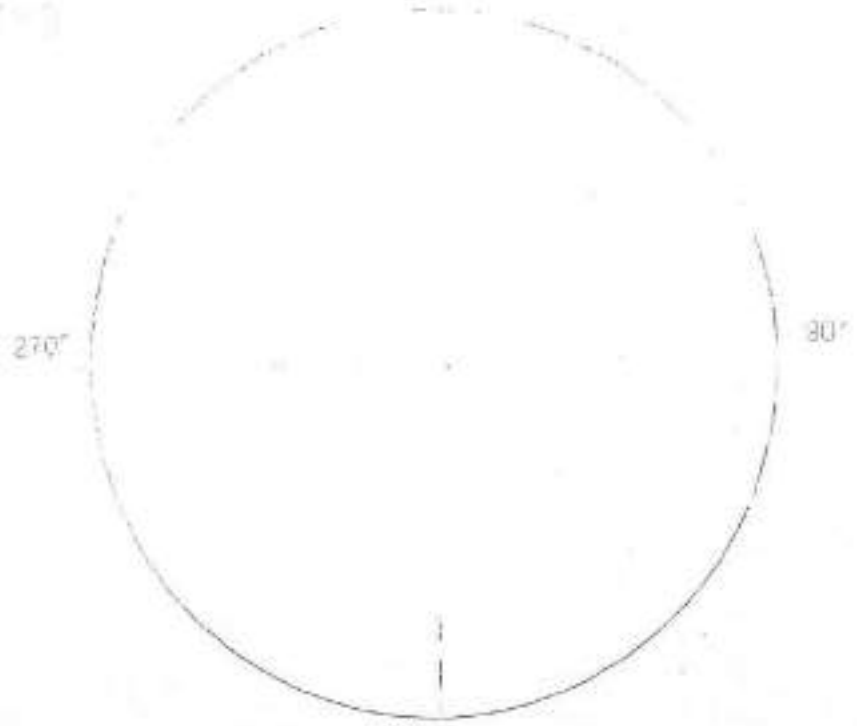
DISCRIPTION	WORK DONE BY	CHECKED BY
Name	Ravi Patel	Kalpesh Patel
Signature	Ravi	

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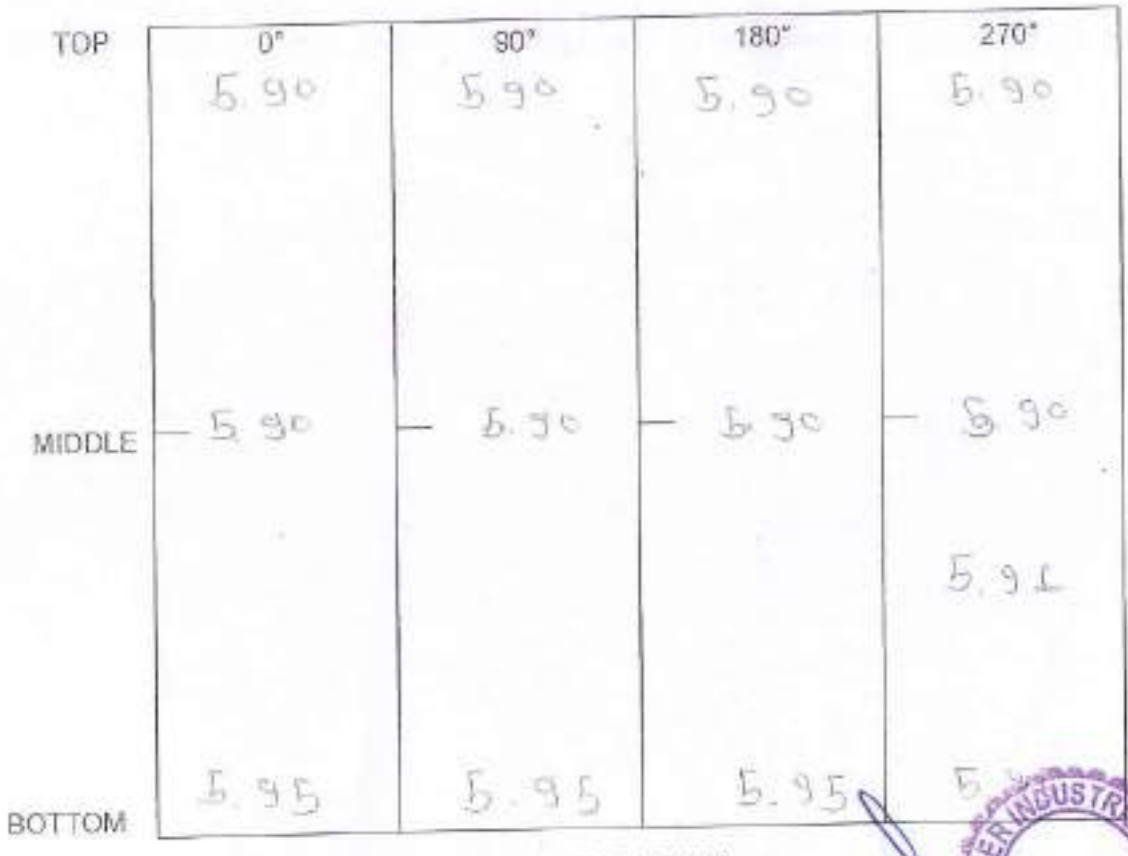
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PLAN



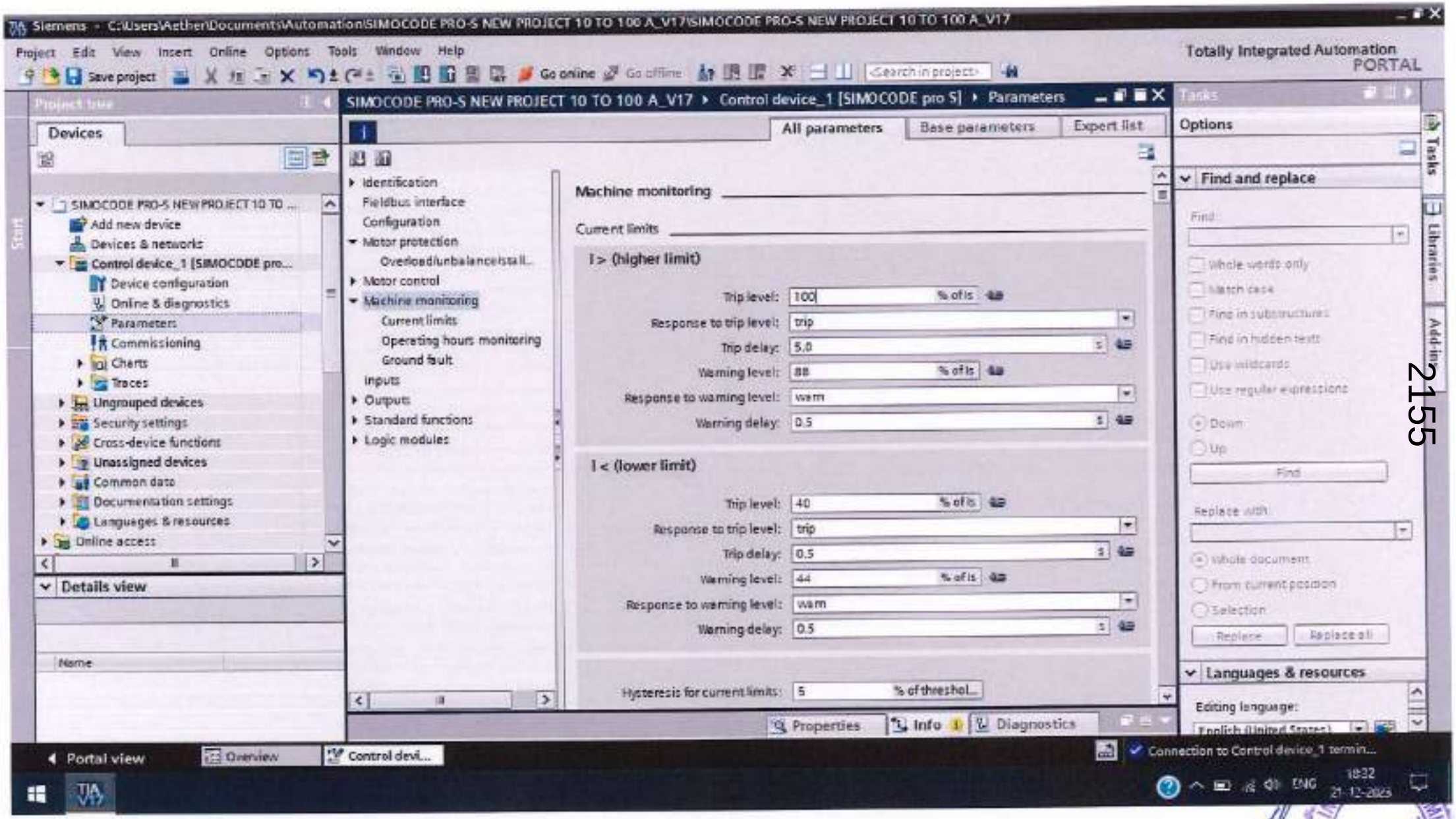
ELEVATION

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	3	45

45

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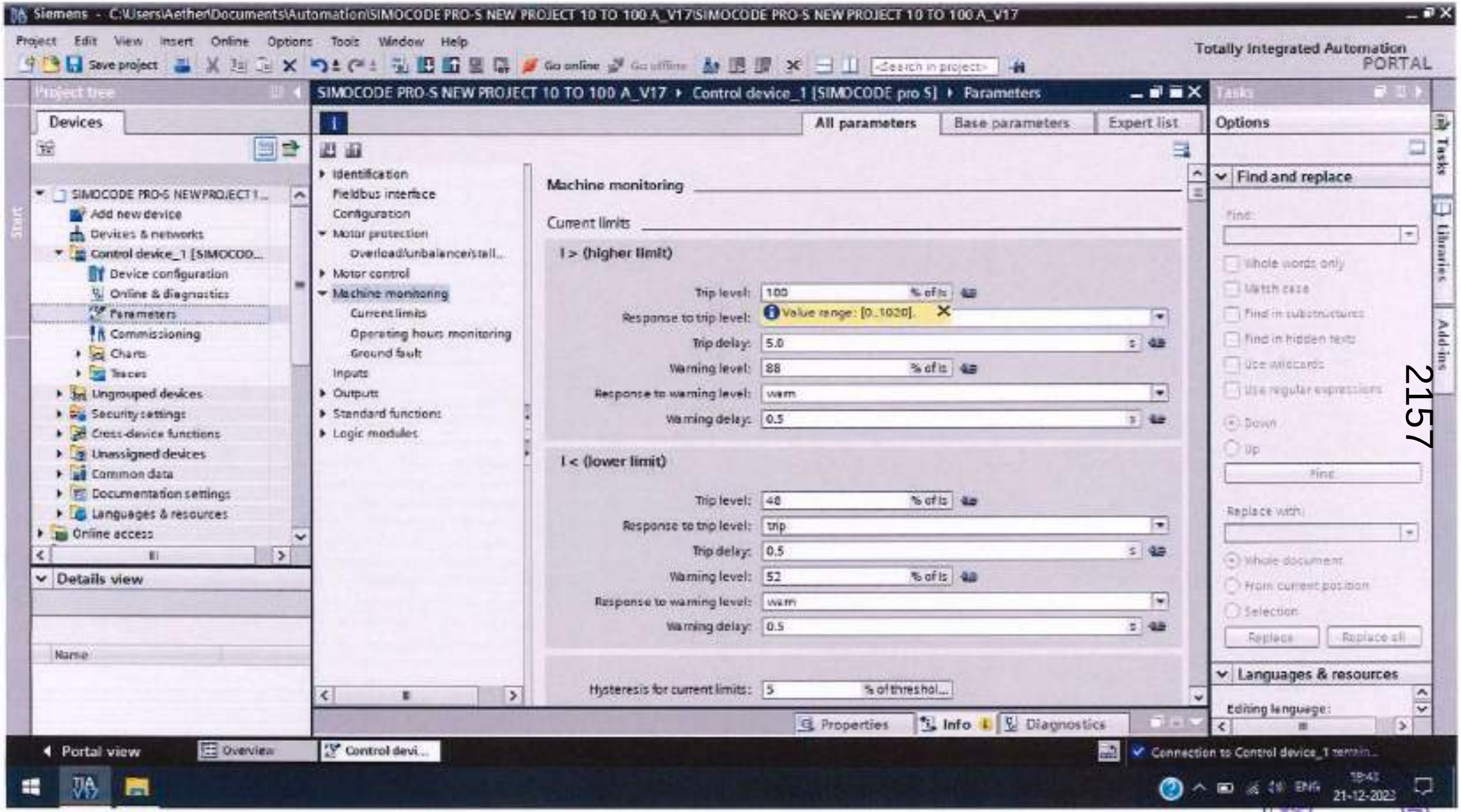

Siemens - C:\Users\Aether\Documents\Automation\SIMOCODE PRO-S NEW PROJECT 10 TO 100 A_V17\SIMOCODE PRO-S NEW PROJECT 10 TO 100 A_V17
Project Edit View Insert Online Options Tools Window Help
Save project
Go online
Go offline
Totally Integrated Automation PORTAL
Devices
SIMOCODE PRO-S NEW PROJECT 10 TO ...
Add new device
Devices & networks
Control device_1 [SIMOCODE pro...
Device configuration
Online & diagnostics
Parameters
Commissioning
Charts
Traces
Ungrouped devices
Security settings
Cross-device functions
Unassigned devices
Common data
Documentation settings
Languages & resources
Online access
Details view
Name
SIMOCODE PRO-S NEW PROJECT 10 TO 100 A_V17 ▸ Control device_1 [SIMOCODE pro S] ▸ Parameters
All parameters
Base parameters
Expert list
Identification
Fieldbus interface
Configuration
Motor protection
Overload/unbalance/stall...
Motor control
Machine monitoring
Current limits
Operating hours monitoring
Ground fault
Inputs
Outputs
Standard functions
Logic modules
Machine monitoring
Current limits
I> (higher limit)
Trip level: 100 % of Is
Response to trip level: trip
Trip delay: 5.0 s
Warning level: 88 % of Is
Response to warning level: warn
Warning delay: 0.5 s
I< (lower limit)
Trip level: 40 % of Is
Response to trip level: trip
Trip delay: 0.5 s
Warning level: 44 % of Is
Response to warning level: warn
Warning delay: 0.5 s
Hysteresis for current limits: 5 % of threshol...
Properties
Info
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Find and replace
Find:
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Find in hidden texts
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Editing language:
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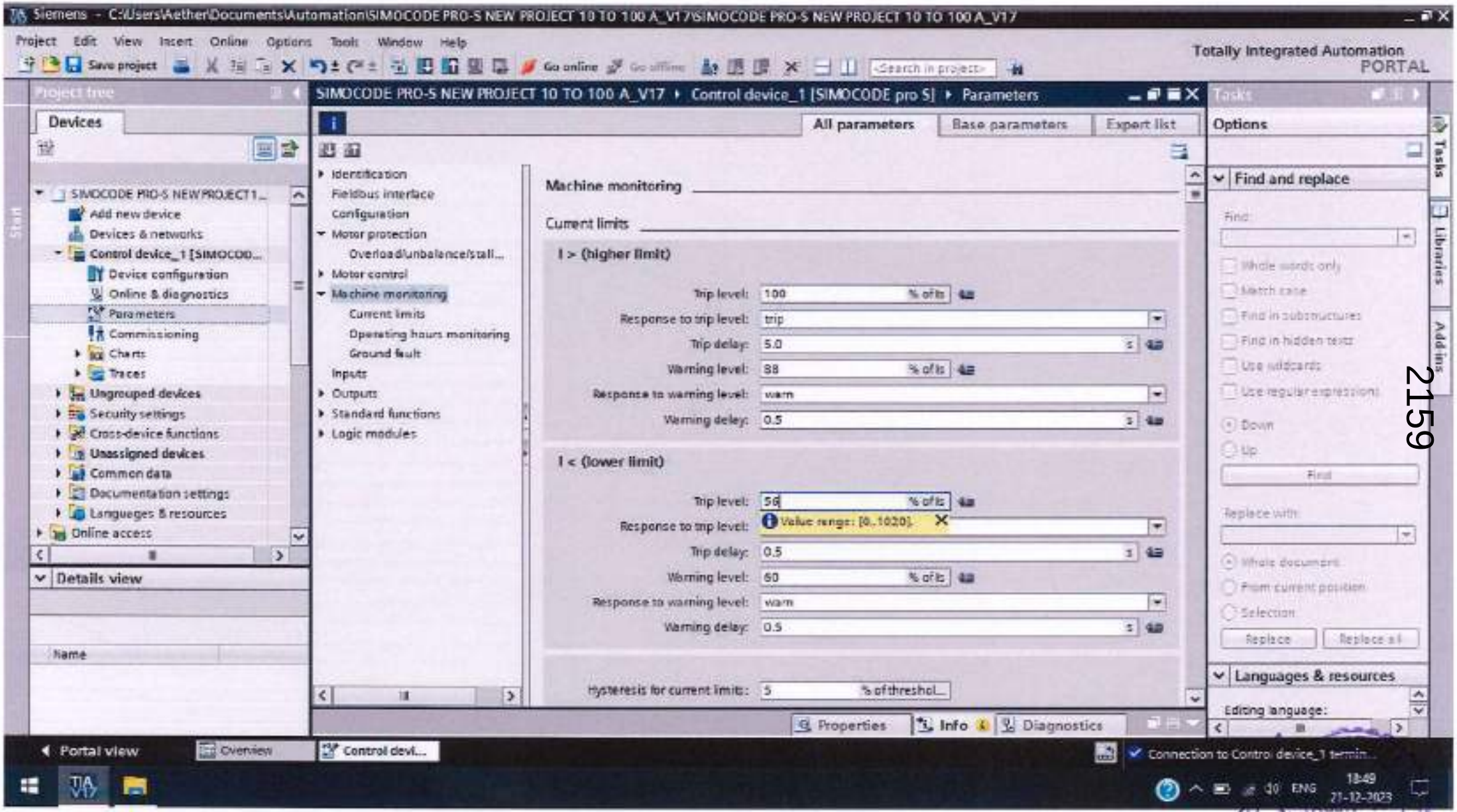
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Node	Stream	Sr. No.	Page Ref. No
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47



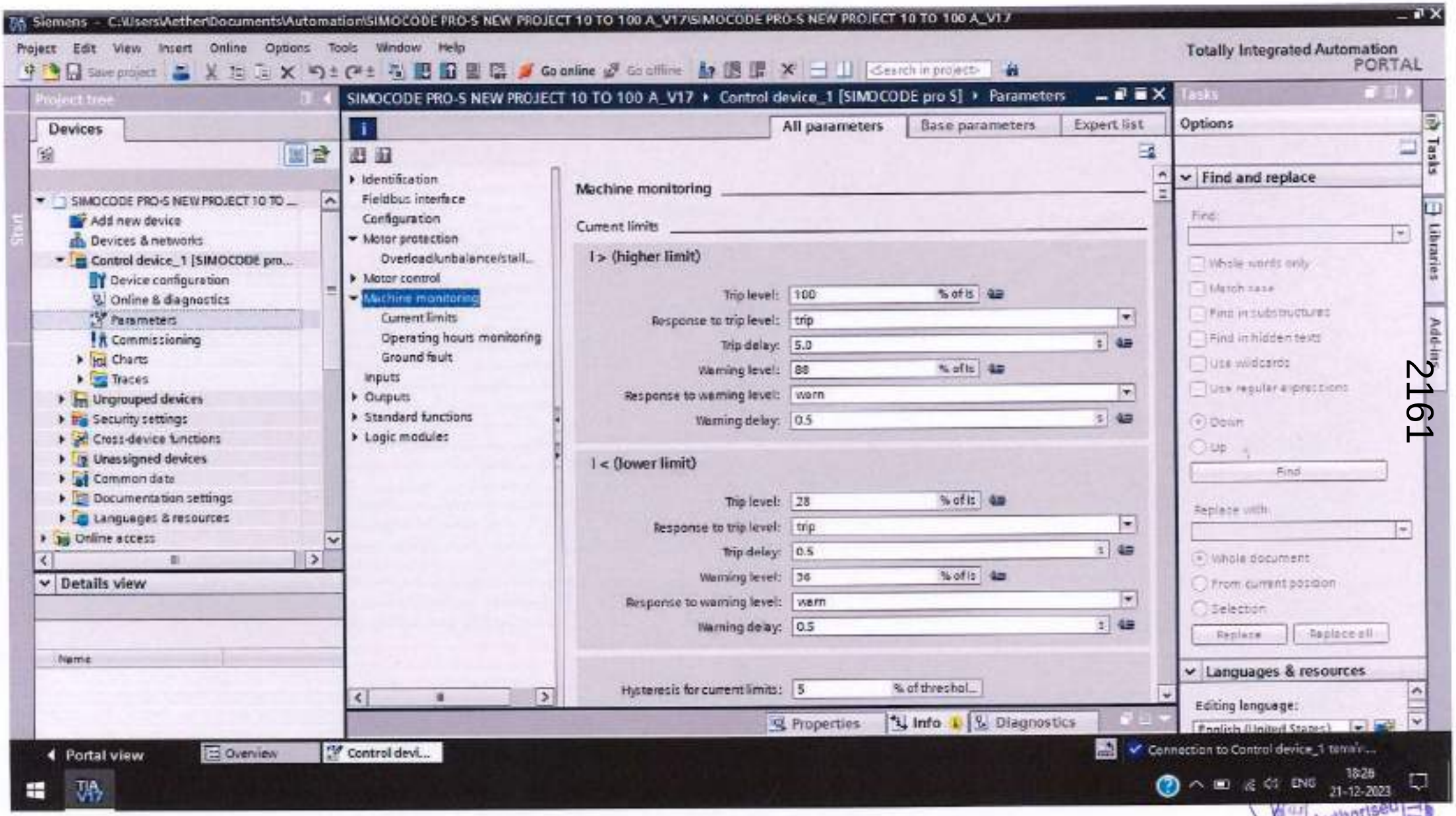

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Response to trip level: trip
Trip delay: 5.0 s
Warning level: 88 % of Ie
Response to warning level: warn
Warning delay: 0.5 s
I < (lower limit)
Trip level: 56 % of Ie
Value range: [0..1020]
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Warning level: 60 % of Ie
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Warning delay: 0.5 s
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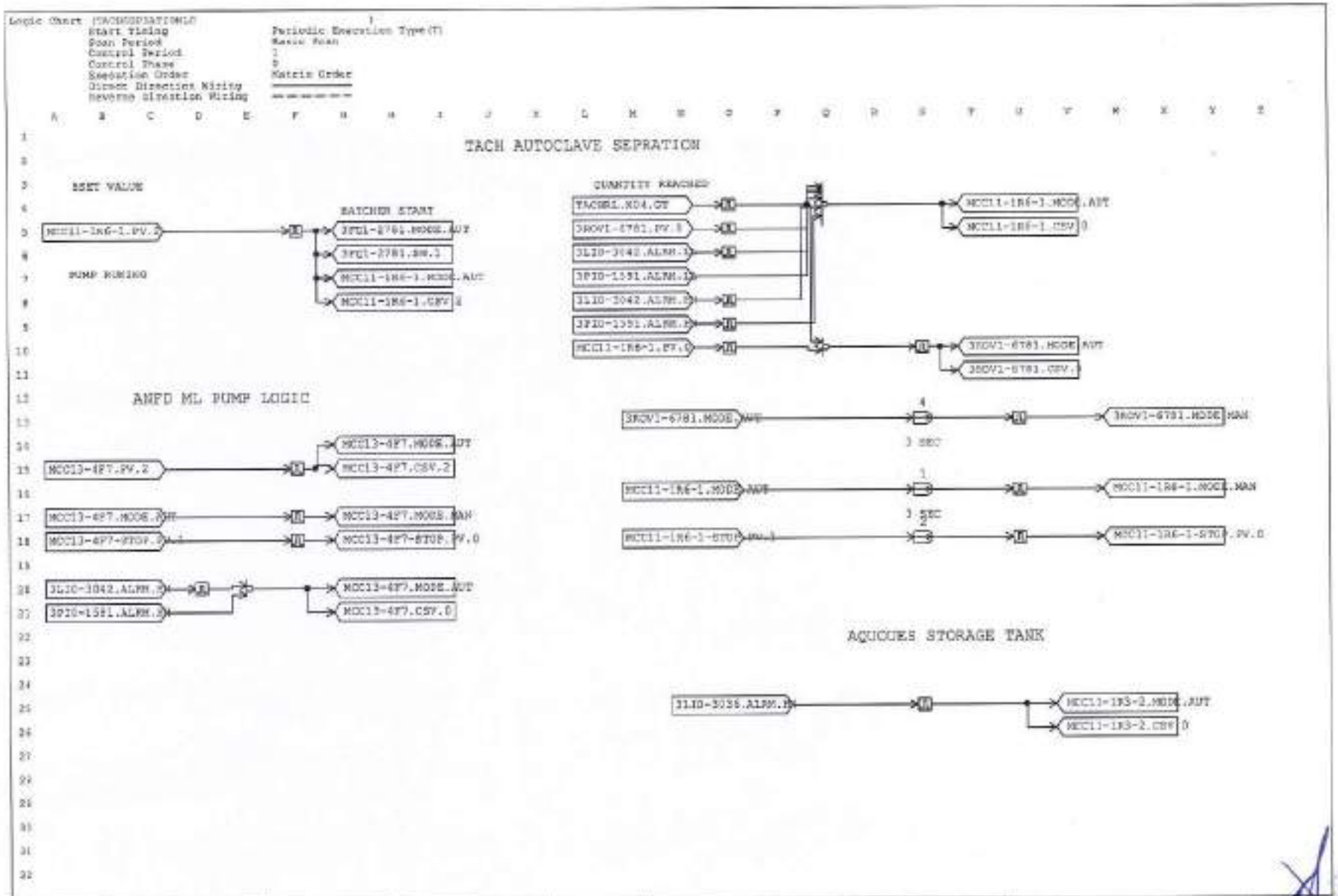

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Outputs
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Logic modules
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Trip level: 100 % of Is
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Warning level: 88 % of Is
Response to warning level: warn
Warning delay: 0.5
I < (lower limit)
Trip level: 28 % of Is
Response to trip level: trip
Trip delay: 0.5
Warning level: 36 % of Is
Response to warning level: warn
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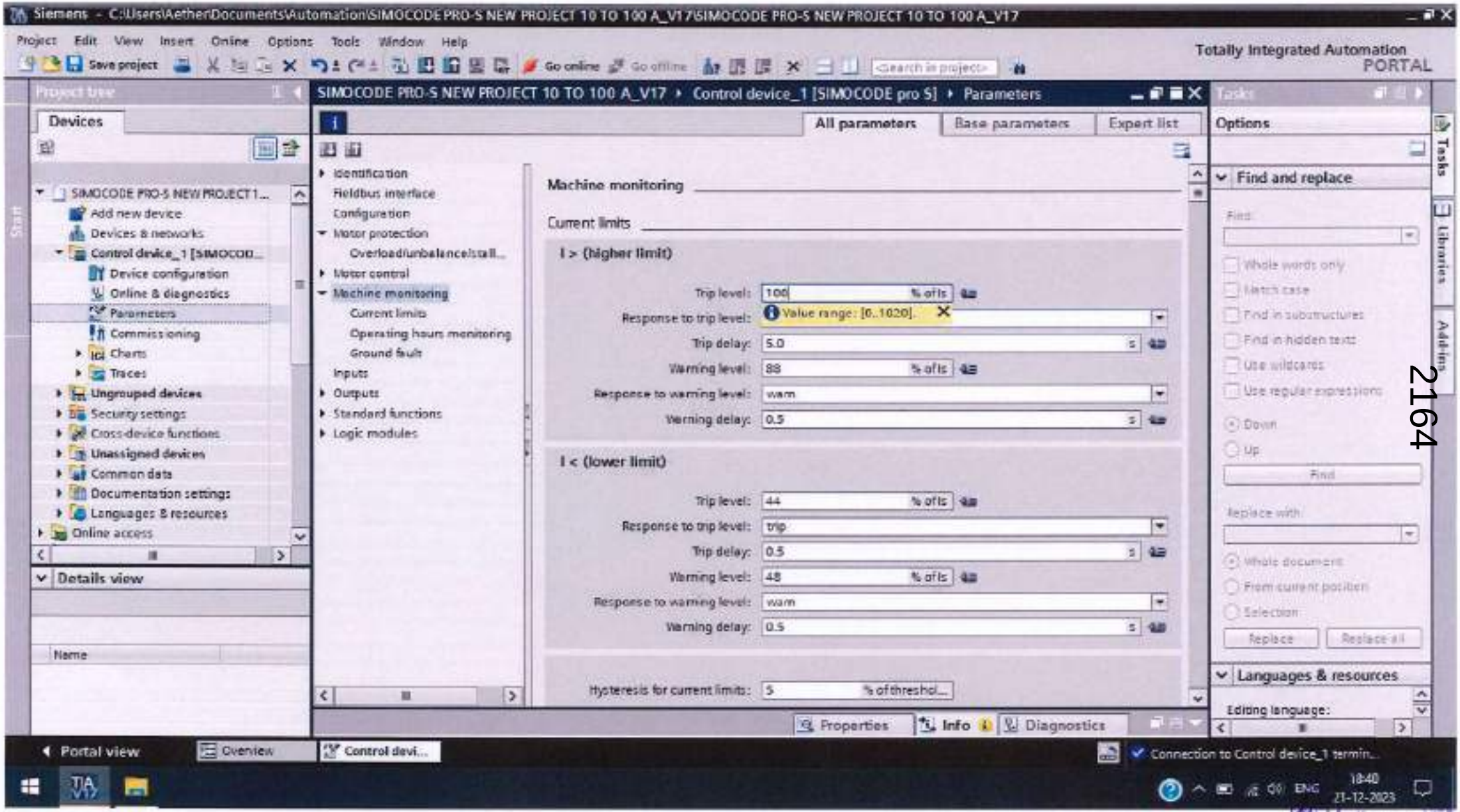
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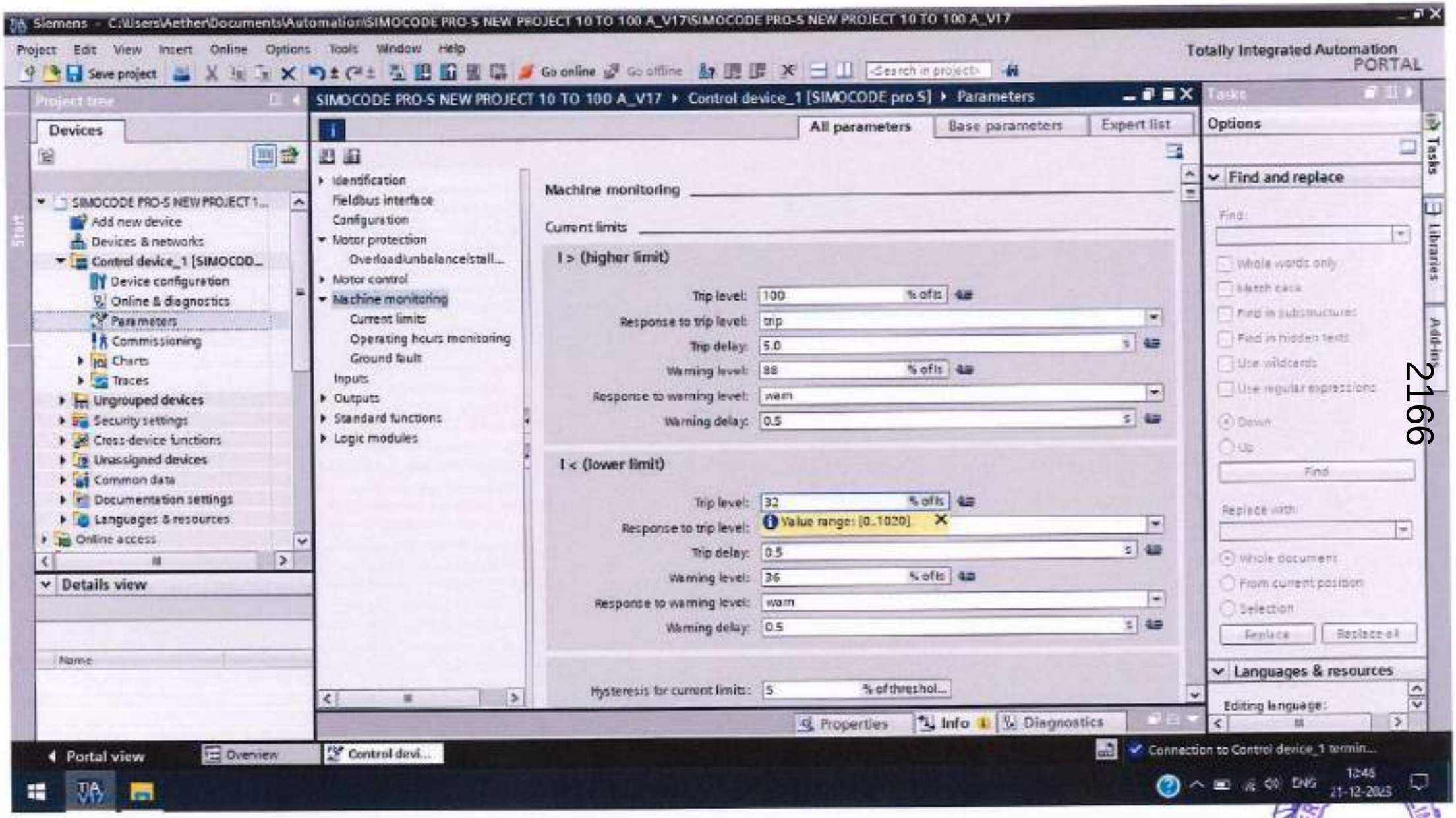
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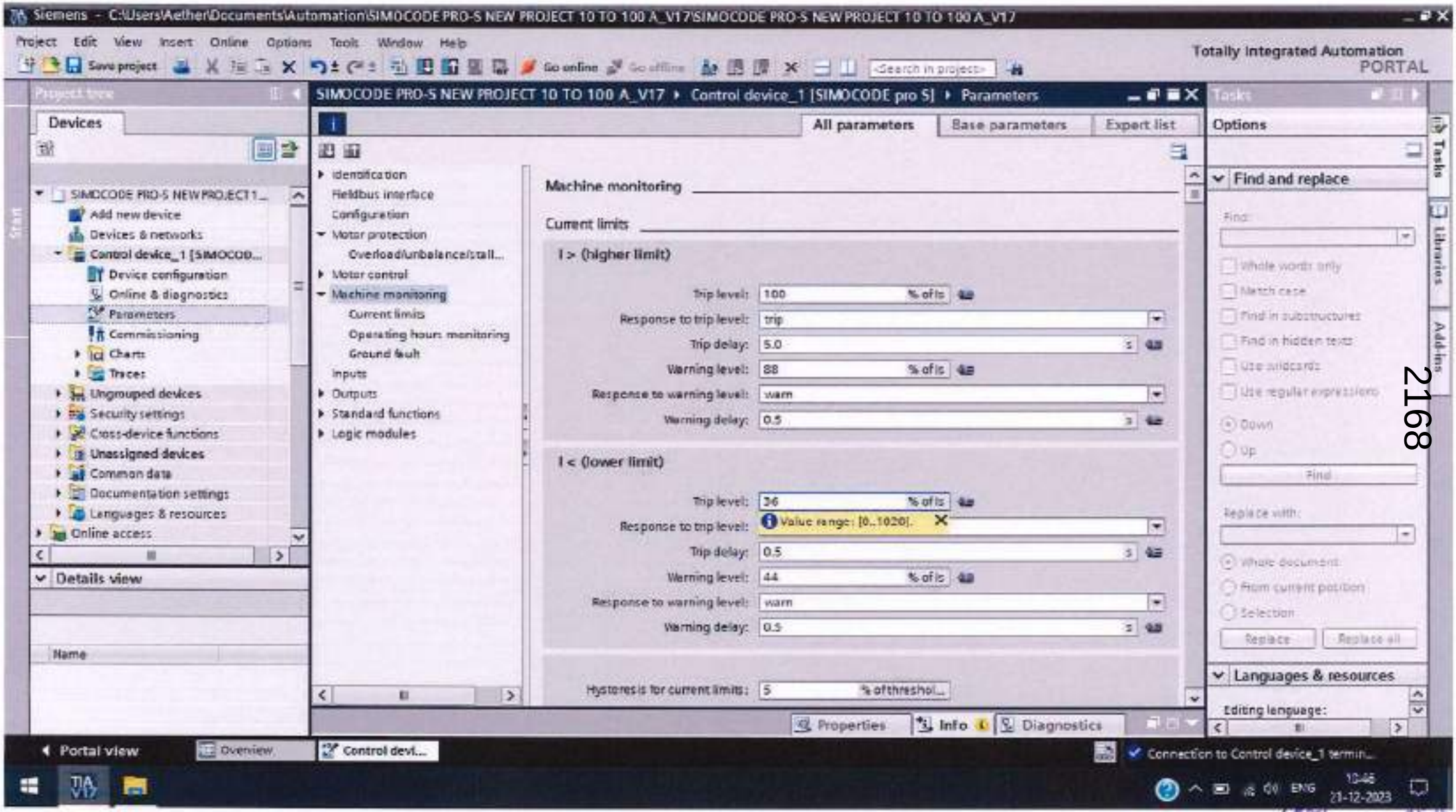
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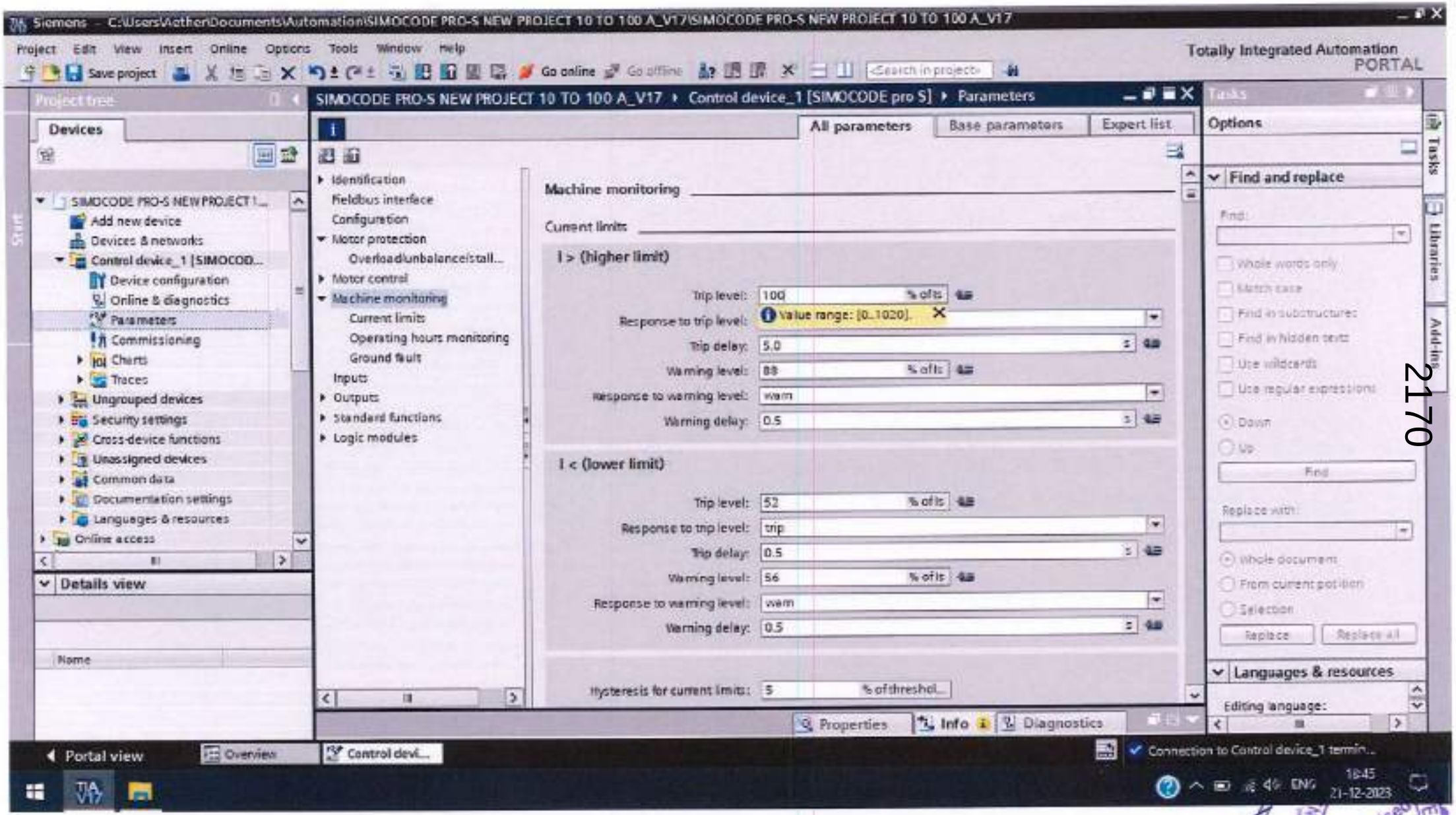
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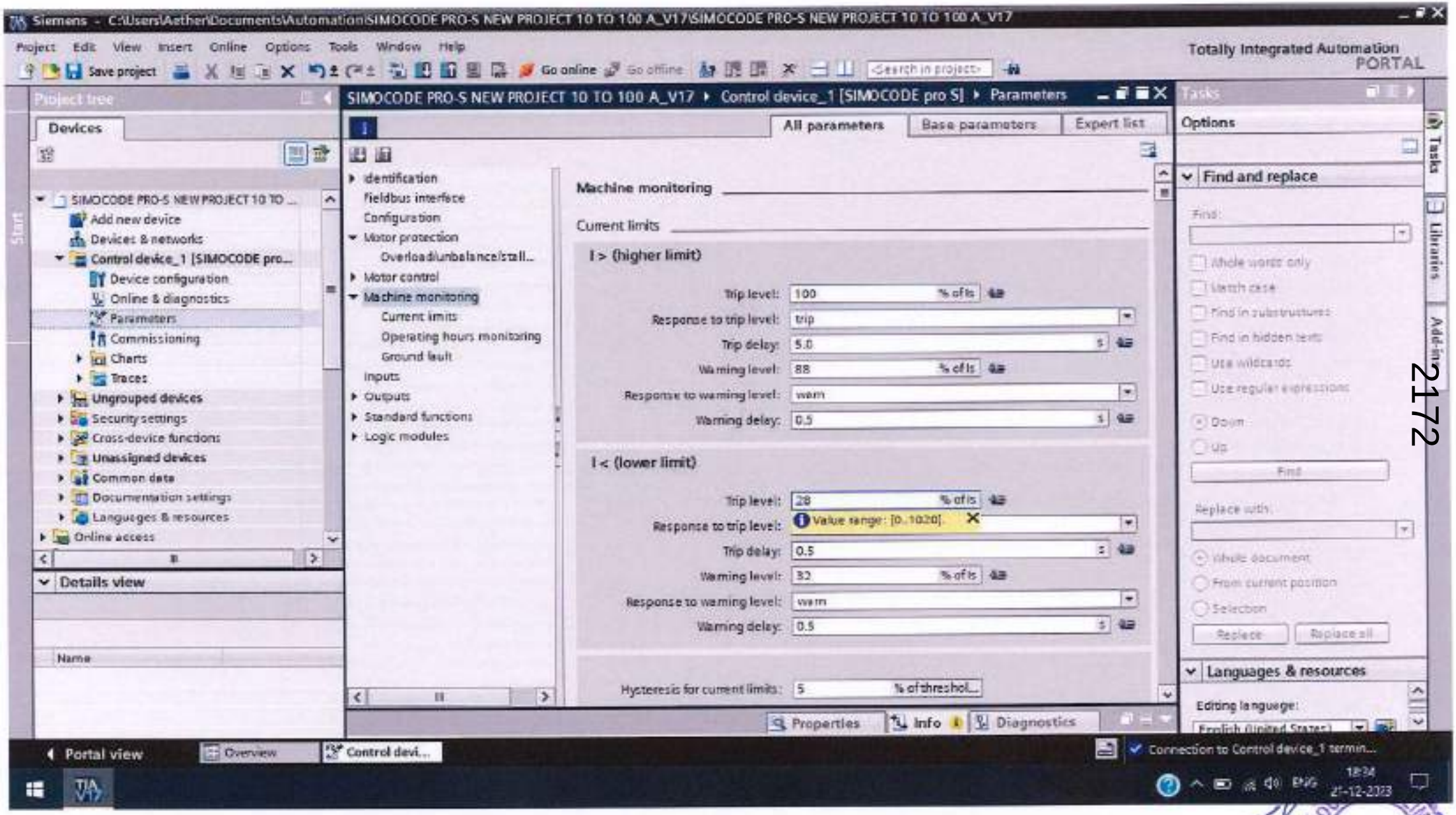
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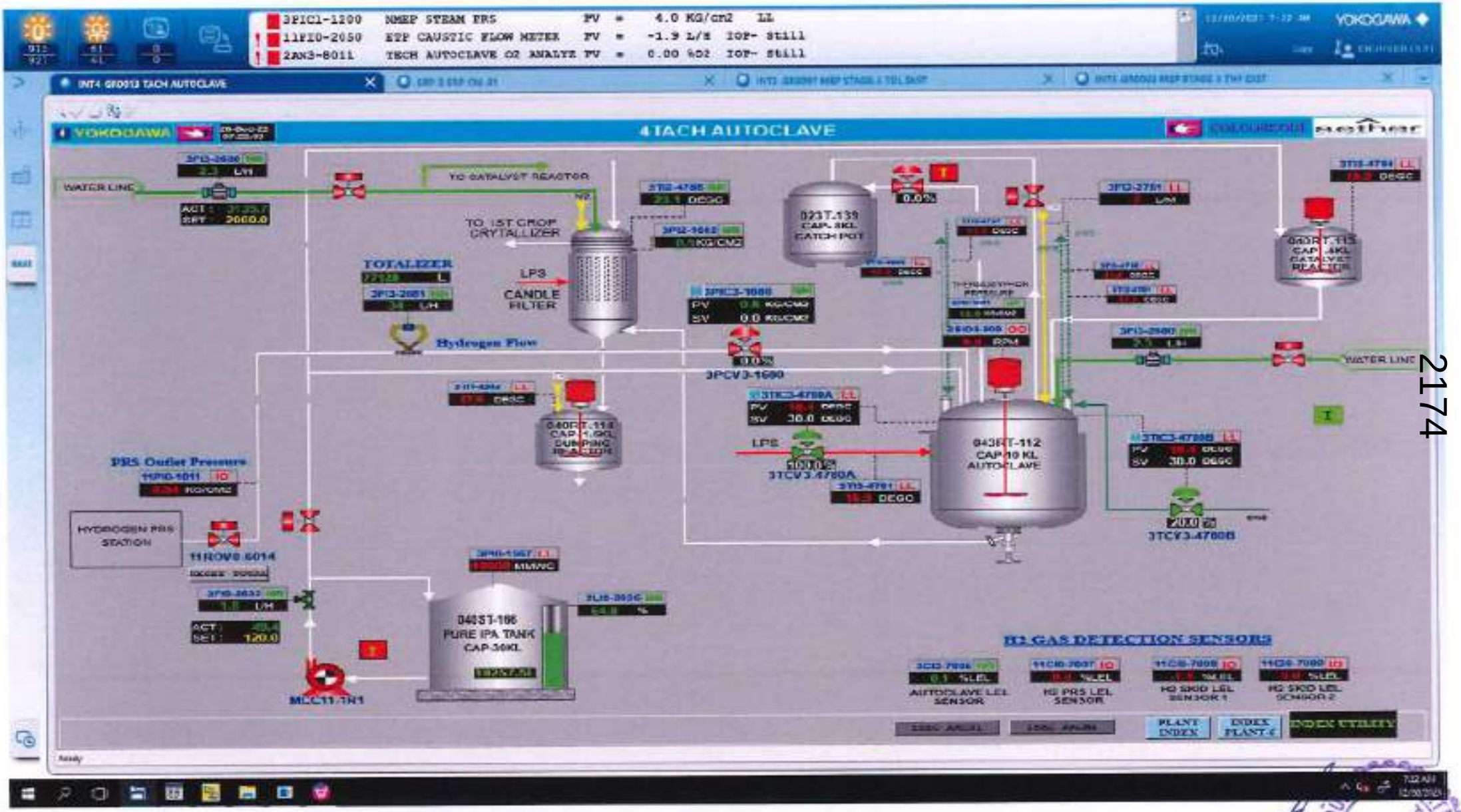
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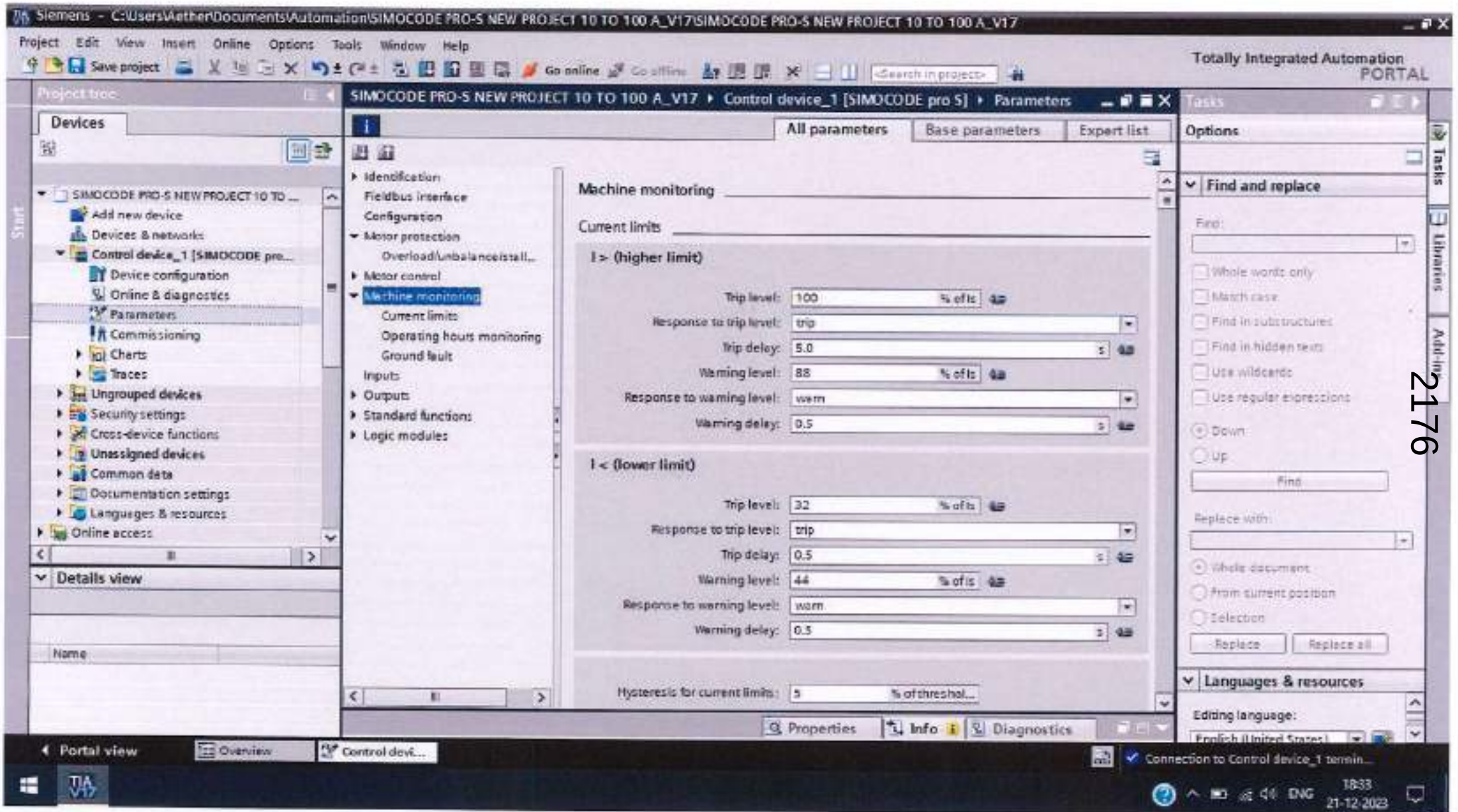
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Outputs
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Current limits
I > (higher limit)
Trip level: 100 % of Is
Response to trip level: trip
Trip delay: 5.0 s
Warning level: 88 % of Is
Response to warning level: warn
Warning delay: 0.5 s
I < (lower limit)
Trip level: 32 % of Is
Response to trip level: trip
Trip delay: 0.5 s
Warning level: 44 % of Is
Response to warning level: warn
Warning delay: 0.5 s
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HAZOP STUDY REPORT OF BPCP PROJECT

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

DECEMER 2023

aether
elementally innovative



NEXA
Process Safety Engineers

2178

AETHER INDUSTRIES LTD.,

SURAT

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HAZOP STUDY REPORT OF

BPCP PROJECT

DECMEBR 2023

By

NEXA PROCESS SAFETY ENGINEERS

NEXA
Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat NEXA PROCESS SAFETY ENGINEERS SURAT **Proprietor**

12/12/2023 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Project BPCP.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether’s safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for BPCP Project.
It has 4 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	Absorption reactor (043RT-097
2.	Quenching Reactor (042RT-098)
3.	Desorption reactor(040RT-100)
4.	BPCP Distillation (041RT-101)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel,

examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

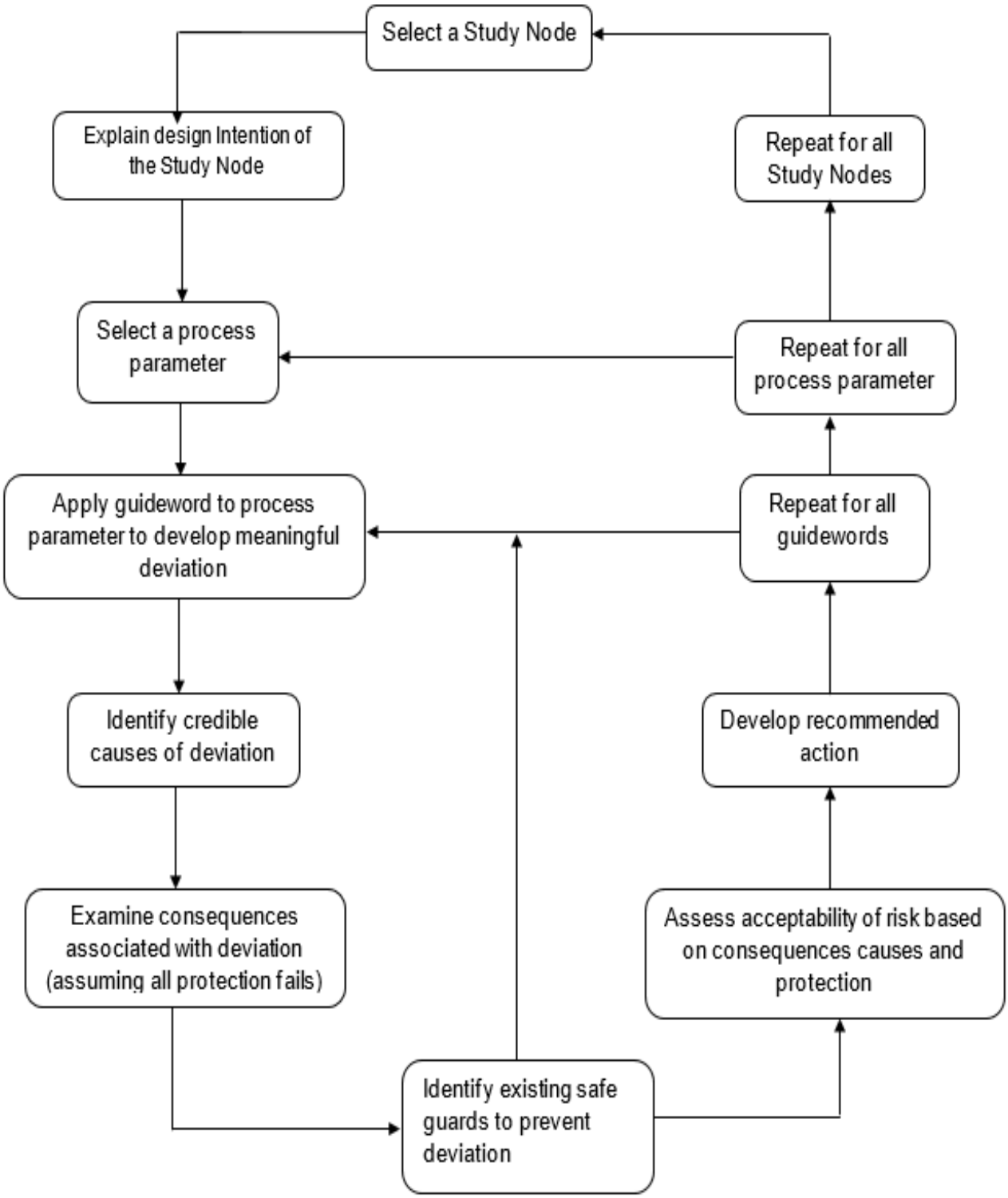
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:**But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:**Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	Available at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop...” Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

Node 1: Absorption reactor (043RT-097)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**PCP charging into reactor (043RT-097)**				
1	Quantity/Flow	No/Less	Human error (Bottom manual valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Loadcell is available in tank for monitoring the level of material. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.
			Human error (manual valve of reaction reactor not opened).	Line may pressurize and lead to spillage /health hazard		
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.
2	Pressure	Low pressure in day tank	1. Human error (Vent line valve of day tank not opened) 2. Vent line chocked	Day tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4.Day tank is design for full vacuum.	1. Vent line valve should be locked open condition with locked open indication tag . 2.Jacketed vent line to be provided.
		High	Human Error (During charging reactor vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	1. Flash alarm to be provide on HH alarm of PT of the reactor.

Node 1: Absorption reactor (043RT-097)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-2		**MCB charging into reactor (043RT-097)**				
7	Quantity/Flow	No/Less	Human error (Bottom manual valve of tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.
			Human error (manual valve of receiving line of reaction reactor not opened).	Line may pressurise and lead to fire hazard and health hazard		
			Line/Flange leakage	Health hazard and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human error (Vent line valve of tank not opened)	Storage tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4. Breather valve is provided in the storage tank.	1. Recommended to provide interlock to stop transferring pump at low low alarm of PT of storage tank.
			Drain valve open/pass in storage tank	Health hazard and fire hazard due to spillage	3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Blind to be provided to all drain point open end flanges. 2.Spill kit to be provided at nearby area to contain the spillage.

Node 1: Absorption reactor (043RT-097)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		High/More	Human error (Wrong input in flow meter)/totaliser	1. Fire hazard due to high flow in reactor. 2. Overflow from reactor	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so,overflow not possible. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	Upper limit of the totaliser to be freezed.
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard.	NRV to be provide in pump discharge line to prevent back flow.
8	Pressure	Low pressure in tank	Breather valve chocked	Storage tank may implode	1.Trained manpower is deputed for operation. 2.PT is available in tank with low low alarm. 3.Breather valve & Flame arrestor PM is performed before start up.	1.Interlock to be provided that transferring pump to be stopped in case of low low value of PT of tank and same time transferring line XV to be closed after 20 sec of pump stop. 2. Flash alarm to be provided at LL alarm value of PT.
		High	Human Error (Charging reactor vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor and same time transferring line XV to be closed after 20 sec of pump stop. 2.Flash alarm to be provide on HH alarm of PT of the reactor.
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up. 3.J pipe is provided in reactor for charging.	1. N2 inertisation to be performed during solvent charging. 2. N2 rotameter to be provided in N2 supply line to ensure nitrogen inertisation. 3. Solvent charging velocity should be less than 1 m/s.

Node 1: Absorption reactor (043RT-097)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Charging line XV air fail safe position is air failed to closed condition.	Recommend to provide interlock so that if XV closed in transferring line than same time transferring pump to be stop.
Stream-4		**IB gas purging into reactor (043RT-097)**				
			CV pass/malfunction		1.PM of CV is performed before start-up. 2. Flow meter is also available in the line to monitor flow.	1. Stroke testing to be performed for the CV periodically.
			Human error (Wrong input in flow meter)totaliser		1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser and via flame arrestor. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	Upper limit of the totaliser to be freezed.
			CV pass/malfunction		1.PM of CV is performed before start-up. 2. High and high high alarms are available in flowmeter. 3. Reactor vapour line is connected with condenser and via flame arrestor. 4. Interlock is available to close charging line CV at HH pressure of reactor & HH temperature of reactor. 5. PT is available in the reactor with high and high high alarms.	1. Flash alarm to be provide on HH alarm of PT & HH alarm of TT of the reactor. 2. Stroke testing to be performed for the CV periodically.
20	Temperature	High	Human error (Steam TCV opened)	Temperature rise may possible	1. TI is available in the reactor with high and high high alarms. 2. CWS and CHWS available in the reactor.	Recommended to provide blind in steam supply line to prevent overheating.

Node 2: Quenching Reactor (042RT-098)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Reaction mass transferring in quenching reactor(042RT-098) from reactor (043RT-097)**				
2	Pressure	High	Human error(Manual vent line valve is not open of reactor)	Reactor may pressurize	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.Trained manpower will operate the operation. and ensure valve position before start operation.	1.Vent line/vapour line valve should be always locked open condition with tag.
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	Flash alarm to be provide on HH value of RTD of the reactor.
		High	Human error(TCV bypass line passed/open)	Temperature rise may possible in reactor	No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
Stream-2		**20% NaOH addition in quenching reactor(042RT-098)**				
7	Pressure	High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is available to stop charging line XV at HH pressure of reactor.	1. Vent line valve should be locked open.

Node 3: Desorption reactor(040RT-100)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Organic layer transferring to desorption reactor (040RT-100)**				

Node 3: Desorption reactor(040RT-100)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
1	Quantity/Flow	No/Less	Line/Flange leakage	Spillage may lead to health hazard & chemical exposure.	1.Line pressure test is performed before start-up. 2.Spill kit is available to contain spillage. 3.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 4.Compatible gasket is used to prevent gasket leakage.	Flange guard to be provided on the flanges.
			Reactor vent valve closed	Reactor may pressurize	1.PT available in the reactor with high & high high alarms. 2.Design pressure of reactor is 6 bar and pressure test is performed before start-up.	1.Double manual valve at drain point to be provided. 2.Flash alarm to be provided to HH value of PT of the reactor.
Stream-2		**Solvent recovery in the desorption reactor (040RT-100)**				
5	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms	1. Interlock to be provided to stop CV in case of vaccum drop & vaccum trip/stops. 2. Interlock to be provided to stop steam CV at vaccum drop & vaccum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.
9	Others	Agitation	Not applicable	-	1. No load tripping is provided.	1. Recommended to provide interlock to stop steam supply line CV at agitator tripping.

NODE 4:BPCP Distillation (041RT-101)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Crude S-1 transferring to 041ST-123**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Spillage may lead to health hazard & chemical exposure.	1.Line pressure test is performed before start-up. 2.Spill kit is available to contain spillage. 3.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 4.Compatible gasket is used to prevent gasket leakage.	Flange guard to be provided on the flanges.
			Storage tank vent valve closed	Tank may pressurize	1.PT available in the tank with high & high high alarms.	1.Interlock to be provided to stop the incoming pump at HH value of PT of the storage tank. 2.Flash alarm to be provided to HH value of PT of the storage tank.
			Flame arrestor chocked	Storage tank may pressurise	1. Choking property material is not stored. 2. PT is available in the storage tank. 3. Flame arrestor PM is performed periodically.	1.Interlock to be provided to stop the incoming pump at HH value of PT of the storage tank. 2.Flash alarm to be provided to HH value of PT of the storage tank.
Stream-2		**BPCP distillation in the desorption reactor (041RT-101)**				
7	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	1. Interlock to be provided to stop CV in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.

NODE 4:BPCP Distillation (041RT-101)						
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
10	Others	Agitation	Not applicable	-	1. No load tripping is provided.	1. Recommended to provide interlock to stop steam supply line CV at agitator tripping.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable””

Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project’s HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		PCP charging into reactor (043RT-097)									
1	Quantity/Flow	No/Less	Human error (Bottom manual valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Loadcell is available in tank for monitoring the level of material. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup.	3	2	6	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.	2	2	4
			Human error (manual valve of reaction reactor not opened).	Line may pressurize and lead to spillage /health hazard								
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Low level in day tank	No HSE hazard/Process Delay	1. Loadcell is available in the tank with alarms. 2.Flow meter is available in transferring line .	3	1	3				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Valve chocked	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Loadcell is available in tank for monitoring the level of material. 3.Flange guard is provided in transferring line. 3.Line pressure test is performed before startup. 5.Jacketed line is provided to prevent line chocking.	3	1	3				
		High/More	Human error (More quantity of material charged)	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so, no chances of overflow. 3. Loadcell is available in day tank to monitor level.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low pressure in day tank	1. Human error (Vent line valve of day tank not opened) 2. Vent line chocked	Day tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4.Day tank is design for full vacuum.	3	3	9	1. Vent line valve should be locked open condition with locked open indication tag . 2.Jacketed vent line to be provided.	2	3	6
		High	Human Error (During charging reactor vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	3	9	1. Flash alarm to be provide on HH alarm of PT of the reactor.	2	3	6
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		**Node Description : Absorption reactor (043RT-097)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	Not applicable									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	UPS failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**MCB charging into reactor (043RT-097)**									
7	Quantity/Flow	No/Less	Human error (Bottom manual valve of tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.LI is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Flange guard is provided in transferring line. 5.Line pressure test is performed before startup.	3	1	3	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.	2	1	2
			Human error (manual valve of receiving line of reaction reactor not opened).	Line may pressurise and lead to fire hazard and health hazard		3	3	9		2	3	6

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Flange leakage	Health hazard and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human error (Vent line valve of tank not opened)	Storage tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4. Breather valve is provided in the storage tank.	3	3	9	1. Recommended to provide interlock to stop transferring pump at low low alarm of PT of storage tank.	2	3	6
			Drain valve open/pass in storage tank	Health hazard and fire hazard due to spillage	3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC	3	3	9	1.Blind to be provided to all drain point open end flanges. 2.Spill kit to be provided at nearby area to contain	2	3	6

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					classification.				the spillage.			
			Human error (Circulation line valve open/pass) in storage tank	Process delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	2	4				
			Low level in storage tank	No HSE hazard/Process Delay	1. LI is available in the day tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				
		High/More	Human error (Wrong input in flow meter)/totaliser	1. Fire hazard due to high flow in reactor. 2. Overflow from reactor	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so,overflow not possible. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	2	6	Upper limit of the totaliser to be freezed.	2	2	4
		Reverse	Pump trip/stop	Pump mechanical failure	No existing safeguard.	3	2	6	NRV to be provide in pump discharge line to prevent back flow.	2	2	4
		Mis-directed flow	No probable cause									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
8	Pressure	Low pressure in tank	Breather valve chocked	Storage tank may implode	1.Trained manpower is deputed for operation. 2.PT is available in tank with low low alarm. 3.Breather valve & Flame arrestor PM is performed before start up.	3	4	12	1.Interlock to be provided that transferring pump to be stopped in case of low low value of PT of tank and same time transferring line XV to be closed after 20 sec of pump stop. 2. Flash alarm to be provided at LL alarm value of PT.	2	4	8
		High	Human Error (Charging reactor vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	4	12	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor.and same time transferring line XV to be closed after 20 sec of pump stop. 2.Flash alarm to be provide on HH alarm of PT of the reactor.	2	4	8
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	Refer low flow									
		High	Refer high flow									
11	Compositio	Other	No probable									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		**Node Description : Absorption reactor (043RT-097)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	n	than	cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 3. Earthing continuity is verified before start-up. 3.J pipe is provided in reactor for charging.	3	3	9	1. N2 inertisation to be performed during solvent charging. 2. N2 rotameter to be provided in N2 supply line to ensure nitrogen inertisation. 3. Solvent charging velocity should be less than 1 m/s.	2	3	6
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Charging line XV air fail safe position is air failed to closed condition.	3	1	3	Recommend to provide interlock so that if XV closed in transferring line than same time transferring pump to be stop.	2	1	2
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**PTSA charging into reactor (043RT-097)**									
13	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard		2	1	2				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human Error (More quantity charged)	No HSE hazard	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	2	1	2				
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	No probable cause									
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	NA									
		High	NA									
17	Others	Static charge	-	Fire hazard	1. Nitrogen inertisation is performed while charging in the reactor. 2. Earthing wrist band is provided to operator who will perform charging activity. 4. Double earthing is provided in the reactor. 5. Earthing continuity is ensured before start-up. 6. Suitable PPE's are available. (Goggles, Face shield, Hand gloves, Dust	3	3	9				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		**Node Description : Absorption reactor (043RT-097)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					Mask) 7. Conductive container is used to contain powder spillage while charging into the reactor.							
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**IB gas purging into reactor (043RT-097)**									
18	Quantity/Flow	Low/Less	Line/Flange leakage	Fire hazard	1.Line pressure and leakage test is performed before start-up. 2. Compatible gasket is used. 3. Line MOC is MS PTFE which is compatible. 4. Fire extinguisher and fire hydrant point is available in the near by area. 5.All electrical installation are flameproof as per HAC classification.	3	3	9				
			CV pass/malfunction		1.PM of CV is performed before start-up. 2. Flow meter is also available in the line to monitor flow.	3	2	6	1. Stroke testing to be performed for the CV periodically.	2	2	4

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Flow meter malfunction	Temperature rise may possible	1. PM of flowmeter is performed before start-up. 2. Interlock is available to stop addition line CV at set value of totaliser.	3	2	6				
			Human error (Wrong input in flow meter)totaliser		1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser and via flame arrestor. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	2	6	Upper limit of the totaliser to be freezed.	2	2	4
			CV pass/malfunction		1.PM of CV is performed before start-up. 2. High and high high alarms are available in flowmeter. 3. Reactor vapour line is connected with condenser and via flame arrestor. 4. Interlock is available to close charging line CV at HH pressure of reactor & HH temperature of reactor. 5. PT is available in the reactor with high and high high alarms.	3	3	9	1. Flash alarm to be provide on HH alarm of PT & HH alarm of TT of the reactor. 2. Stroke testing to be performed for the CV periodically.	2	3	6

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
19	Pressure	Low	No probable cause									
		High	Vent line valve not opened (Human Error)	Reactor may pressurize	1. PT is available in the reactor with high and high high alarms. 2. Interlock is available to stop addition line CV at HH pressure of reactor. 3. Vent line valve is kept locked open all the time to prevent human error. 4. Reactor design pressure is 6 bar and leakage pressure test is performed before start-up.	3	3	9				
20	Temperature	Low	No probable cause									
		High	Refer high flow									
			Human error (Steam TCV opened)	Temperature rise may possible	1. TI is available in the reactor with high and high high alarms. 2. CWS and CHWS available in the reactor.	3	3	9	Recommended to provide blind in steam supply line to prevent overheating.	2	3	6
21	Level	Low	No probable cause									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 07/12/2023			
Node 1		Node Description : Absorption reactor (043RT-097)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture	Overflow from reactor and lead to spillage/health hazard	1. Jacket PM is performed before start-up. 2. Utility media is compatible with the reaction mass.	2	3	6				
22	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the addition line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.							
		Power Failure	GEB power failure	No HSE hazard	DG power backup is provided to the reactor.	3	1	3				
		Instrument Air Failure	Air compressor failure	No HSE hazard	1.CV of charging line air fail safe position is air fail to close. 2. Air compressor running indication is available on DCS along with the PT in supply line.	3	3	9				
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Motor decoupled	Line may pressurize and lead to fire hazard and health hazard	1. Interlock is available to stop addition line CV at agitator stops.	2	3	6				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 2		Node Description : Quenching Reactor (042RT-098)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Reaction mass transferring in quenching reactor(042RT-098) from reactor (043RT-097)										
1	Quantity/Flow	No/Less	Line leakage	Health hazard & fire hazard due to spillage	1. Line pressure test is performed before start-up. 2. Flange guard is provided in all the flanges. 3. Spillkit is available in the nearby area. 4. Fire extinguisher and fire hydrant point is provided in near by area. 5.All electrical installation as per HAC classification.	2	3	6				
2	Pressure	Low	No probable cause	No HSE hazard								
		High	Human error(Manual vent line valve is not open of reactor)	Reactor may pressurize	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.Trained manpower will operate the operation. and ensure valve position before start operation.	3	2	6	1.Vent line/vapour line valve should be always locked open condition with tag.	2	2	4
3	Temperature	Low	Human error(Chilling water supply	No HSE hazard/Process Delay								

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 2		Node Description : Quenching Reactor (042RT-098)										
			valve open)									
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	3	3	9				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 2		**Node Description : Quenching Reactor (042RT-098)**									
					5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.						
			Reactor leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of jacket is performed periodically.	3	3	9			
		High	Refer High/More flow								
5	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9			
Stream-2		**20% NaOH addition in quenching reactor(042RT-098)**									
6	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	2	4			
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.						
			Line leakage	No HSE hazard	-						
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	1	3			
		High/Mo	Human error	No HSE hazard							

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 2	**Node Description : Quenching Reactor (042RT-098)**										
		re	(Wrong input in totaliser)								
		Mis-directed flow	Manual valve pass								
7	Pressure	Low	No probable cause								
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is available to stop charging line XV at HH pressure of reactor.	3	4	12	1. Vent line valve should be locked open.	2	4	8
8	Temperature	Low	No probable cause	No HSE hazard							
		High	No probable cause	No HSE hazard							
9	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6			
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6			

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 2	Node Description : Quenching Reactor (042RT-098)										
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6			
		High	Refer High/More flow								
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay							
		Power Failure	GEB power failure	No HSE hazard/Process Delay							
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay							
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay							

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		Node Description : Desorption reactor(040RT-100)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Organic layer transferring to desorption reactor (040RT-100)										
1	Quantity/ Flow	No/Less	Line/Flange leakage	Spillage may lead to health hazard & chemical exposure.	1.Line pressure test is performed before start-up. 2.Spill kit is available to contain spillage. 3.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 4.Compatible gasket is used to prevent gasket leakage.	3	2	6	Flange guard to be provided on the flanges.	2	2	4
			Reactor vent valve closed	Reactor may pressurize	1.PT available in the reactor with high & high high alarms. 2.Design pressure of reactor is 6 bar and pressure test is performed before start-up.	3	3	9	1.Double manual valve at drain point to be provided. 2.Flash alarm to be provided to HH value of PT of the reactor.	3	3	9
2	Level	Low	Refer low Flow									
		High	Refer high Flow									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		**Node Description : Desorption reactor(040RT-100)**										
3	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the addition line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		**Solvent recovery in the desorption reactor (040RT-100)**										
4	Quantity/ Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 3		**Node Description : Desorption reactor(040RT-100)**									
5	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms	3	3	9	1. Interlock to be provided to stop CV in case of vaccum drop & vaccum trip/stops. 2. Interlock to be provided to stop steam CV at vaccum drop & vaccum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.	2	3	6
		High Vacuum	No HSE hazard								
6	Temperature	Low	No HSE hazard								
		High	Refer low pressure								
7	Level	Low	Reactor leakage Bottom valve pass/leakage	Chemical spillage & Exposure Fire hazard	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3. All nearby electrical installations are flameproof. 4. Fire hydrant post & extinguishers are available in the nearby area. 5. Double manual valve available to prevent	3	3	9			

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 3		Node Description : Desorption reactor(040RT-100)									
					valve passing.						
		High	No probable cause								
8	Composition	Other than	No probable cause								
9	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2.Vacuum breaking in system is done by nitrogen only.	3	3	9			
		Instrument Air failure	-		1.TCV in steam line and PCV of vacuum line is air failed to closed condition.						
		Power Failure	GEB power failure	-	DG is available for power backup.	3	2	6			
		DCS Failure	GEB power failure		Battery backup is available.	3	2	6			
		Agitation	Not applicable	-	1. No load tripping is provided.	3	4	12	1. Recommended to provide interlock to stop steam supply line CV at agitator tripping.	2	4	8

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : BPCP Distillation (041RT-101)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Crude S-1 transferring to 041ST-123**										
1	Quantity/ Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	4	1	4				
			Line/Flange leakage	Spillage may lead to health hazard & chemical exposure.	1.Line pressure test is performed before start-up. 2.Spill kit is available to contain spillage. 3.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 4.Compatible gasket is used to prevent gasket leakage.	3	2	6	Flange guard to be provided on the flanges.	2	2	4
			Human Error (Discharge Valve not opened)	Transferring line pressurization	1.Line is designed to resist maximum discharge pressure of pump to prevent line rupture. 2.PG is available in discharge line to monitor pressure. 3.Overload tripping is provided in pump. 4.Trained manpower will perform transferring	3	2	6				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : BPCP Distillation (041RT-101)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					activity.							
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				
			Storage tank vent valve closed	Tank may pressurize	1.PT available in the tank with high & high high alarms.	3	3	9	1.Interlock to be provided to stop the incoming pump at HH value of PT of the storage tank. 2.Flash alarm to be provided to HH value of PT of the storage tank.	2	3	6
			Flame arrestor chocked	Storage tank may pressurise	1. Choking property material is not stored. 2. PT is available in the storage tank. 3. Flame arrestor PM is performed periodically.	3	3	9	1.Interlock to be provided to stop the incoming pump at HH value of PT of the storage tank. 2.Flash alarm to be provided to HH value of PT of the storage tank.	2	3	6
		High/More	Fixed capacity centrifugal pump is used so high flow not possible.									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 4		**Node Description : BPCP Distillation (041RT-101)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in the pump discharge line to prevent reverse flow.	3	2	6				
2	Pressure	High	Refer high Flow									
3	Level	Low	Refer low Flow									
		High	Refer high Flow									
4	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		**BPCP distillation in the desorption reactor (041RT-101)**										
5	Quantity/ Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed	No probable cause									

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : BPCP Distillation (041RT-101)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		flow										
6	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high alarms.	3	3	9	1. Interlock to be provided to stop CV in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.	2	3	6
7	Temperature	High	Refer low pressure									
8	Level	Low	Reactor leakage Bottom valve pass/leakage	Chemical spillage & Exposure	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3. All nearby electrical installations are flameproof. 4. Double manual valve available to prevent valve passing.	3	3	9				
9	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2.Vacuum breaking in	3	3	9				

P&ID of BPCP Plant_4		Title : HAZOP study of BPCP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : BPCP Distillation (041RT-101)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					system is done by nitrogen only.							
		Instrument Air failure	-		1.TCV in steam line and PCV of vacuum line is air failed to closed condition.							
		Power Failure	GEB power failure	-	DG is available for power backup.	3	2	6				
		DCS Failure	GEB power failure		Battery backup is available.	3	2	6				
		Agitation	Not applicable	-	1. No load tripping is provided.	3	4	12	1. Recommended to provide interlock to stop steam supply line CV at agitator tripping.	2	4	8

|| END OF THE REPORT ||

BPCP HAZOP Report Recommendations Status

Node	Stream	Sr. No.	Recommendations Absorption reactor (043RT-057)	Status	Action Taken	Page Ref.
Node 1	Stream-1	1	PCP charging into reactor (043RT-097)			
Node 1	Stream-1	2	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-1	3	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
Node 1	Stream-1	4	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 1	Stream-1	5	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-1	6	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 1	Stream-1	7	1. Vent line valve should be locked open condition with locked open indication tag.	Completed	Implemented in Field	3
Node 1	Stream-1	8	2.Jacketed vent line to be provided.	Completed	Implemented in Field	4
Node 1	Stream-1	9	1. Flash alarm to be provide on HH alarm of PT of the reactor.	Completed	Implemented in DCS	5
Node 1	Stream-2		MCB charging into reactor (043RT-097)			
Node 1	Stream-2	10	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-2	11	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
Node 1	Stream-2	12	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 1	Stream-2	13	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
Node 1	Stream-2	14	2.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Node 1	Stream-2	15	1. Recommended to provide interlock to stop transferring pump at low low alarm of PT of storage tank.	Completed	Implemented in DCS	6
Node 1	Stream-2	16	1.Blind to be provided to all drain point open end flanges.	Completed	Implemented in Field	7
Node 1	Stream-2	17	2.Spill kit to be provided at nearby area to contain the spillage.	Completed	Implemented in Field	1
Node 1	Stream-2	18	Upper limit of the totaliser to be freezed.	Completed	Implemented in DCS	8
Node 1	Stream-2	19	NRV to be provide in pump discharge line to prevent back flow.	Completed	Implemented in Field	8
Node 1	Stream-2	20	1.Interlock to be provided that transferring pump to be stopped in case of low low value of PT of tank and same time transferring line XV to be closed after 20 sec of pump stop.	Completed	Implemented in DCS	6
Node 1	Stream-2	21	2. Flash alarm to be provided at L.L alarm value of PT.	Completed	Implemented in DCS	9
Node 1	Stream-2	22	1. Interlock to be provided to stop the charging pump at HH value of PT of reactor and same time transferring line XV to be closed after 20 sec of pump stop.	Completed	Implemented in DCS	6
Node 1	Stream-2	23	2.Flash alarm to be provide on HH alarm of PT of the reactor.	Completed	Implemented in DCS	9
Node 1	Stream-2	24	1. N2 inertisation to be performed during solvent charging.	Completed	Implemented in Field	-
Node 1	Stream-2	25	2. N2 rotameter to be provided in N2 supply line to ensure nitrogen inertisation.	Completed	Implemented in Field	10
Node 1	Stream-2	26	3. Solvent charging velocity should be less than 1 m/s.	Completed	Implemented in Field	-
Node 1	Stream-2	27	Recommend to provide interlock so that if XV closed in transferring line than same time transferring pump to be stop.	Completed	Implemented in DCS	6
Node 1	Stream-4		IB gas purging into reactor (043RT-097)			
Node 1	Stream-4	28	1. Stroke testing to be performed for the CV periodically.	Completed	Implemented in DCS	10
Node 1	Stream-4	29	Upper limit of the totaliser to be freezed.	Completed	Implemented in DCS	8
Node 1	Stream-4	30	1. Flash alarm to be provide on HH alarm of PT & HH alarm of TT of the reactor.	Completed	Implemented in DCS	9
Node 1	Stream-4	31	2. Stroke testing to be performed for the CV periodically.	Completed	Implemented in DCS	10
Node 1	Stream-4	32	Recommended to provide blind in steam supply line to prevent overheating.	Completed	Implemented in Field	11
Node 2			Quenching Reactor (043RT-098)			
Node 2	Stream-1		Reaction mass transferring in quenching reactor(042RT-098) from reactor (043RT-097)			
Node 2	Stream-1	33	1.Vent line/vapour line valve should be always locked open condition with tag.	Completed	Implemented in Field	3
Node 2	Stream-1	34	Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	9
Node 2	Stream-1	35	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	15
Node 2	Stream-2		20% NaOH addition in quenching reactor(042RT-098)			
Node 2	Stream-2	36	1. Vent line valve should be locked open.	Completed	Implemented in Field	3
Node 3			Desorption reactor(040RT-100)			
Node 3	Stream-1		Organic layer transferring to desorption reactor (040RT-100)			
Node 3	Stream-1	37	Flange guard to be provided on the flanges.	Completed	Implemented in Field	12
Node 3	Stream-1	38	1.Double manual valve at drain point to be provided.	Completed	Implemented in Field	13
Node 3	Stream-1	39	2.Flash alarm to be provided to HH value of PT of the reactor.	Completed	Implemented in DCS	9
Node 3	Stream-2		Solvent recovery in the desorption reactor (040RT-100)			
Node 3	Stream-2	40	1. Interlock to be provided to stop CV in case of vaccum drop & vaccum trip/stops.	Completed	Implemented in DCS	14
Node 3	Stream-2	41	2. Interlock to be provided to stop steam CV at vaccum drop & vaccum pump trip/stops.	Completed	Implemented in DCS	14
Node 3	Stream-2	42	3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor.	Completed	Implemented in DCS	14
Node 3	Stream-2	43	4. Flash alarm to be provided at HH temperature of the reactor.	Completed	Implemented in DCS	9
Node 3	Stream-2	44	1. Recommended to provide interlock to stop steam supply line CV at agitator tripping.	Completed	Implemented in DCS	14
Node 4			BPCP Distillation (041RT-101)			
Node 4	Stream-1		Crude S-1 transferring to 041ST-123			

Node 4	Stream-1	45	Flange guard to be provided on the flanges.	Completed	Implemented in Field	12
Node 4	Stream-1	46	1.Interlock to be provided to stop the incoming pump at HH value of PT of the storage tank.	Completed	Implemented in DCS	16
Node 4	Stream-1	47	2.Flash alarm to be provided to HH value of PT of the storage tank.	Completed	Implemented in DCS	9
Node 4	Stream-1	48	1.Interlock to be provided to stop the incoming pump at HH value of PT of the storage tank.	Completed	Implemented in DCS	16
Node 4	Stream-1	49	2.Flash alarm to be provided to HH value of PT of the storage tank.	Completed	Implemented in DCS	9
Node 4	Stream-2		BPCP distillation in the desorption reactor (041RT-101)			
Node 4	Stream-2	50	1. Interlock to be provided to stop CV in case of vacuum drop & vacuum trip/stops.	Completed	Implemented in DCS	17
Node 4	Stream-2	51	2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	17
Node 4	Stream-2	52	3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor.	Completed	Implemented in DCS	17
Node 4	Stream-2	53	4. Flash alarm to be provided at HH temperature of the reactor.	Completed	Implemented in DCS	9
Node 4	Stream-2	54	1. Recommended to provide interlock to stop steam supply line CV at agitator tripping.	Completed	Implemented in DCS	17

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	2	1
		5	
	Stream-2	10	
		13	
		17	

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VENUS
V-SORB SPILL KIT UNIVERSAL
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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-1	3	2
	Stream-2	11	

2

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JINDAL PIPES LIMITED

WORKS(MILL) TEST CERTIFICATE

(ERW PIPES)

T.C No. : JPL/E-V/QC/2866/2022
T.C Date : 11/11/2023
Process/Product : GI PIPE

Customer : MUGATLAL B. & SONS
O.C. No. : 1137
W.O. No. : VS/TI/2673/23-24

1.WE CERTIFY THAT THE MATERIAL DESCRIBED BELOW FULLY CONFIRM TO IS:1239 (PT1) 2004.CHEMICAL COMPOSITION.MECHANICAL/PHYSICAL PROPERTIES AND DIMENSIONS OF THE PRODUCT HAVE BEEN TESTED IN ACCORDANCE WITH THE SCHEME OF TESTING AND INSPECTION CONTAINED IN BIS CERTIFICATION MARKS LICENCE NO.CM/L:7487695

	Description				Quantity			HydroStatic Testing	
S No.	Size	Specification	Heat No.	Coil No	Pcs	Length (in mtrs)	End Finish	Pressure (KG/CM2)	Holding Time (Sec)
1	B.K 88.90 X 4.80 X 6000MM HEAVY P/E	IS:1239(PT-1)	7357855	7855-S-23I-2006	60	360.00	P/E	51	3
2	G.I 33.40 X 4.00 X 6000MM HEAVY P/E	IS:1239(PT-1)	7357867	7867-S-23I-1925	179	1075.79	P/E	51	3
3	G.I 114.30 x 5.40 x 6000 MM HEAVY P/E	IS:1239(PT-1)	8020995	0995-J-23I-2288	41	247.18	P/E	51	3

IS:1239(PT-1)

			Mechanical Properties						Chemical Composition (%)						
S No.	Heat No.	Coil No.	YST (Mpa)	UTS (Mpa)	EL (%)	Flattening	Bend Test	LA/PA	C	Mn	S	P	Si	AL	C.E.
	Required Values	Min. Max.	NA					LA	0.200	1.300	0.040	0.040			
1	7357855	7855-S-23I-2006	NA	405.92	26.66	OK	NA	LA	0.070	0.260	0.018	0.023	0.099	0.033	
2	7357867	7867-S-23I-1925	NA	394.22	24.26	NA	OK	LA	0.070	0.250	0.017	0.020	0.085	0.029	
3	8020995	0995-J-23I-2288	NA	406.24	25.28	OK	NA	LA	0.062	0.323	0.015	0.012	0.018	0.055	

1. Dimensions : OUTSIDE DIAMETER,THICKNESS,WEIGHT,LENGTH,CONFIRM TO ABOVE SPECIFICATION
2. RUST Preventive : ALL PIPES/TUBES ARE COATED WITH BLACK RUST PREVENTIVE, FROM OUT SIDE SURFACE ONLY.
3. Coating Galvanising : ALL PIPES/TUBES ARE GALVANISHED INSIDE AND OUTSIDE SURFACE AS PER 154736 SPEC.PW ZINC USED WITH ZINC CONTENT OF 98.5% ABOVE
4. Threading : AS PER IS554

Normal Informations: Applicable for Varnish Sino 1,2 . GI Sino 1,3 . GI SWS 1,3,4 .

MARKING/STENCELLING :

IS:1239(PT-1)
HEAVY
CM/L 7487695

Remarks : The above pipes has been manufactured at M/s. Vibhor Steel Tubes Pvt. Limited, under the supervision of JPL
S&S : Screwed & Socketed SWS: Screwed without Socketed EL(%): Upto 25 mm NB is 12 EL(%): Above 25 mm NB is 20

SEAL

For JINDAL PIPES LIMITED

(Authorised Signatory)

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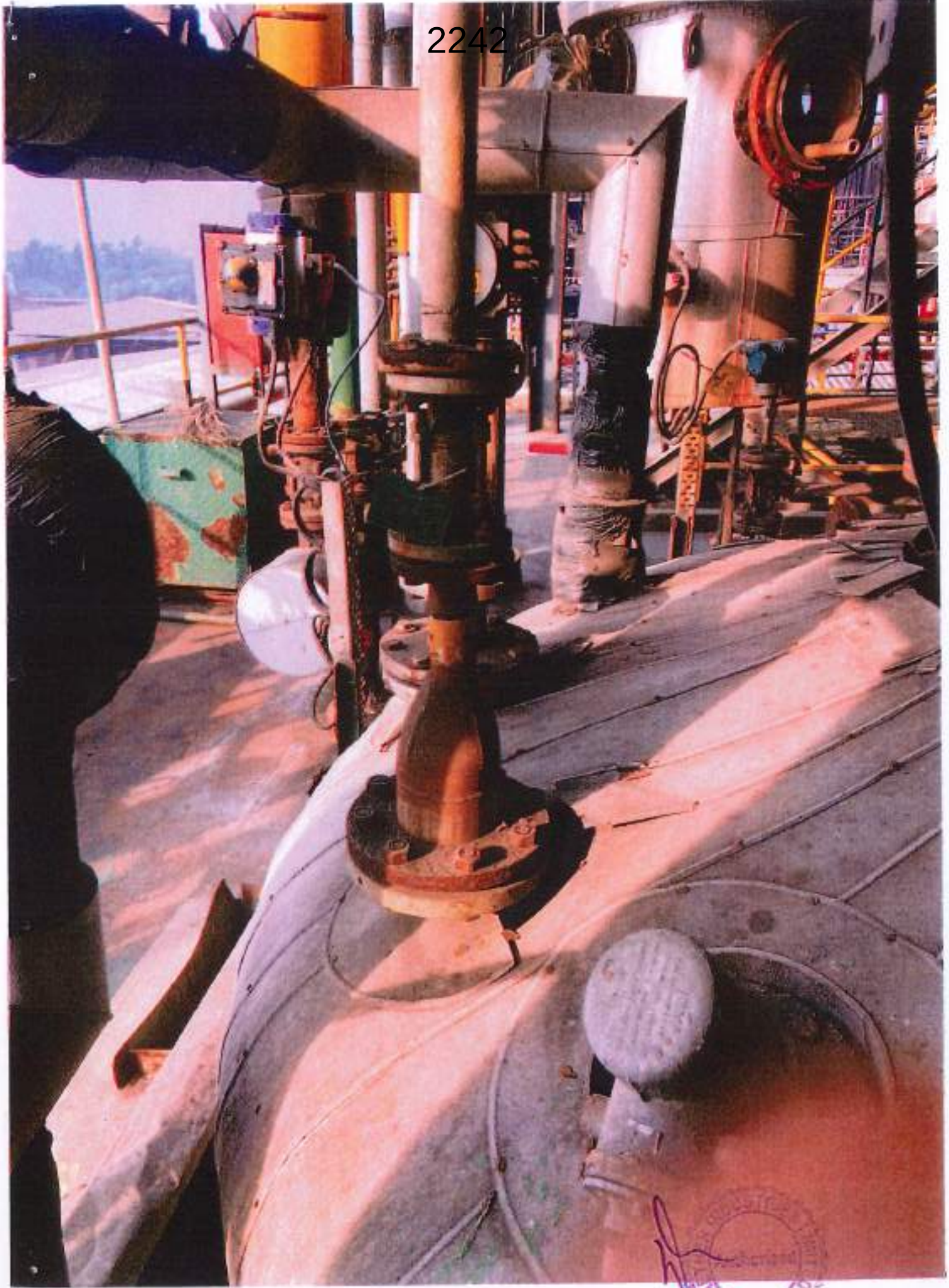
YST:Yield Strength, UTS:Ultimate Tensile Strength,EL: Elongation,PE: Plain End,BE: Bevel End, LA:Ladle Analysis, PA:Product Analysis,NA: Not Applicable W.&R.O.:GUT NO :69/2,PIPENAGAR,N.H.17,B.K.G.ROAD,VILLAGE-SUKELI,DIST-RAIGAD,MAHARASHTRA-402126Phone :02194238880

2240

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Node 2	Stream-1	33	
	Stream-2	36	

3

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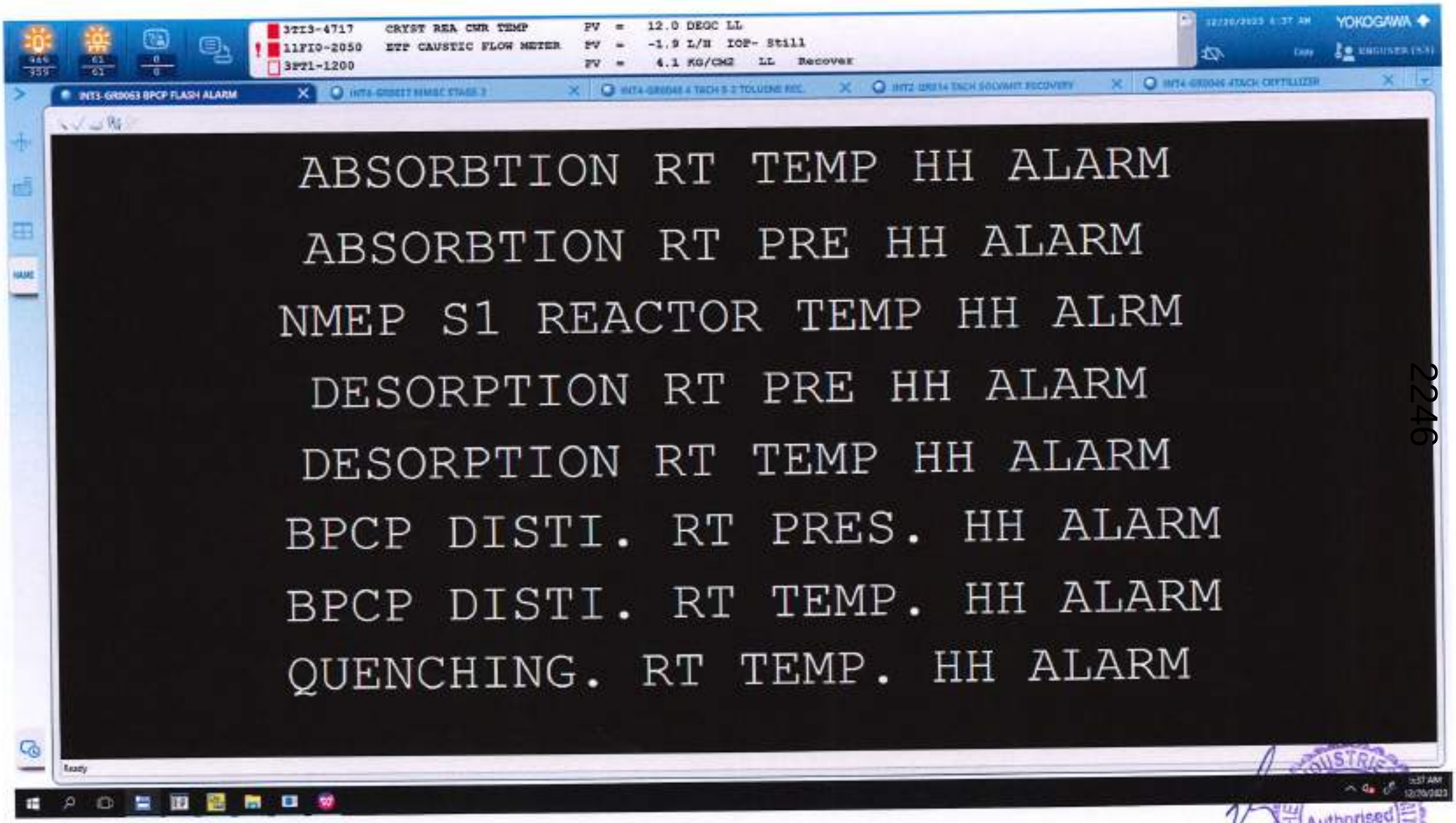


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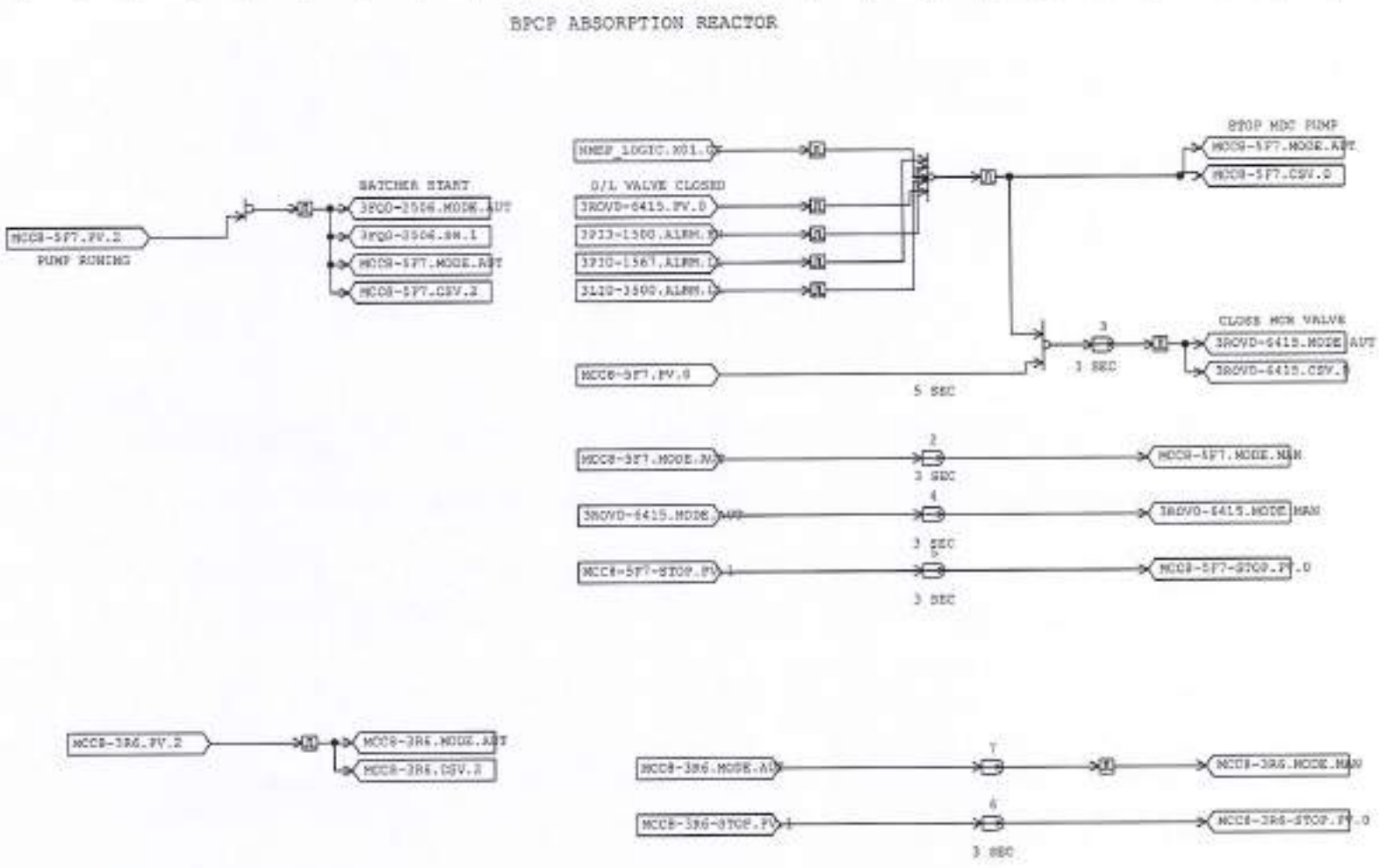
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		20	
		22	
		27	

6

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Logic Chart :NMEP_01_LC MCB CHARGING 1

Start Timing	Periodic Execution Type(T)
Scan Period	Basic Scan
Control Period	1
Control Phase	0
Execution Order	Matrix Order
Direct Direction Wiring	————
Reverse Direction Wiring	————



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SECTION:		PRINTED DATE:	12/20/2023	DRAWER:	

YOKOGAWA

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Node 1	Stream-2	16	7

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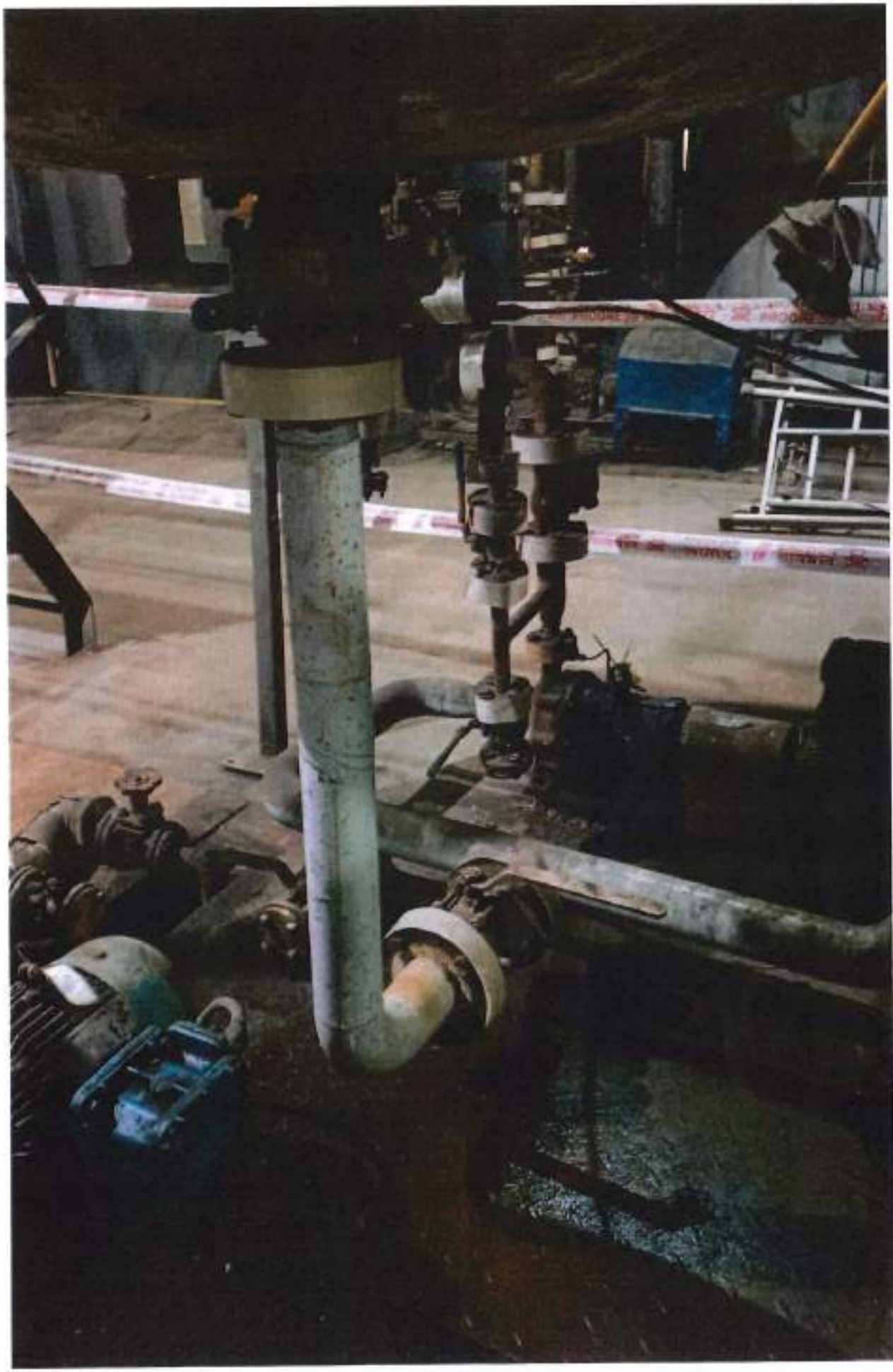
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THK LINE CRYSTALLIZER

Node	Stream	Sr. No.	Page Ref. No
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8

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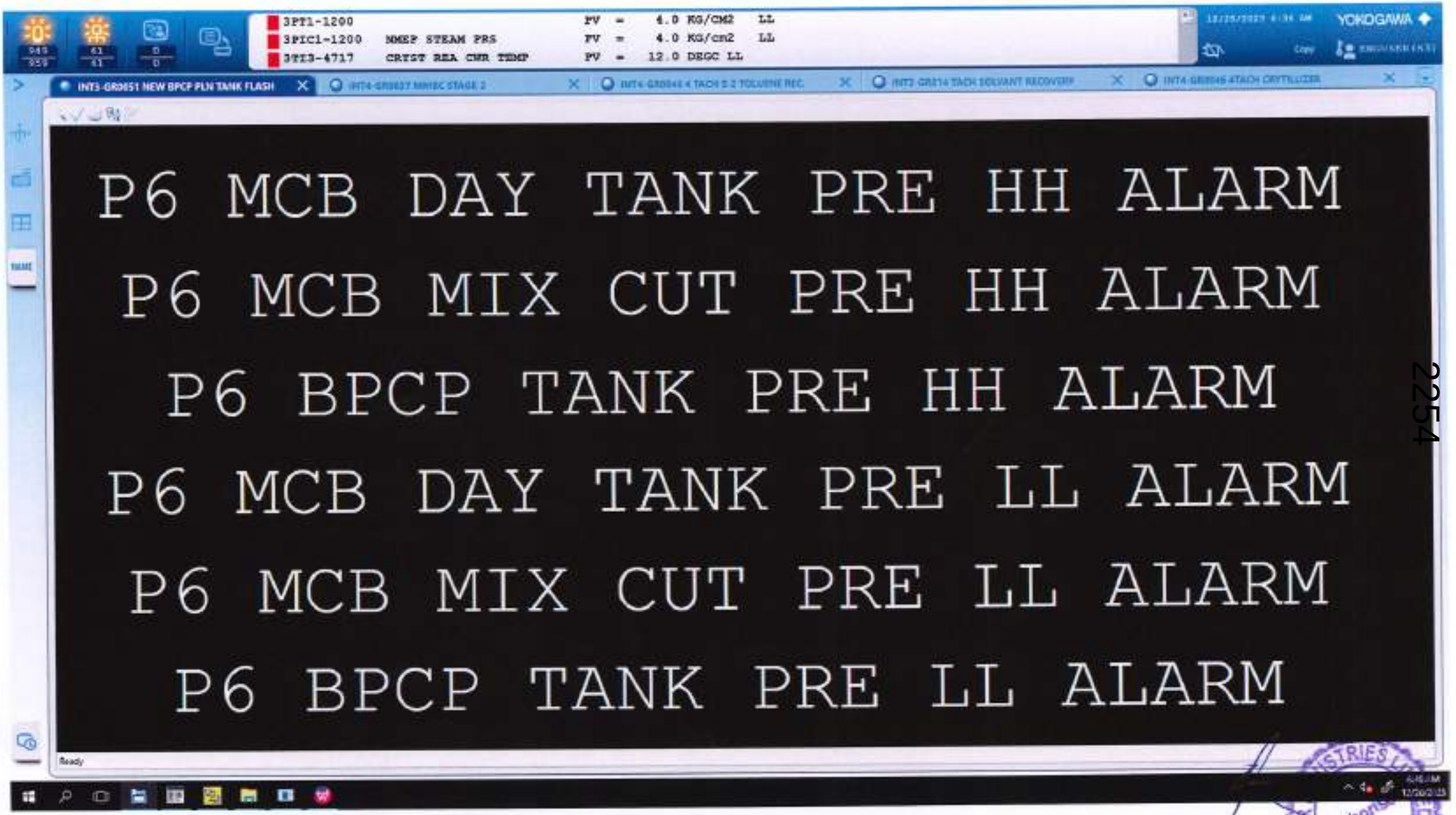


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	Stream-4	29	
	Stream-4	30	
Node 2	Stream-1	34	
Node 3	Stream-1	39	
	Stream-2	43	
Node 4	Stream-1	47	
		49	
Node 4	Stream-2	53	

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3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 NMEP STEAM PRS PV = 4.0 KG/cm2 LL
3TI3-4717 CRYST REA CWR TEMP PV = 12.0 DEGC LL
YOKOGAWA
INT5-GR0651 NEW BPCP PLN TANK FLASH
P6 MCB DAY TANK PRE HH ALARM
P6 MCB MIX CUT PRE HH ALARM
P6 BPCP TANK PRE HH ALARM
P6 MCB DAY TANK PRE LL ALARM
P6 MCB MIX CUT PRE LL ALARM
P6 BPCP TANK PRE LL ALARM
Ready

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-4	28	10
	Stream-4	31	

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MONTHLY CONTROL VALVE STOCK CHECK SCHEDULE (FY2023-24)

SR NO.	PLANT NAME	TAG NO.	SERVICE	CONTROL VALVE OPENING STATUS FROM DCS				DATE	DONE BY	CHECK BY	REMARKS
				25%	50%	75%	100%				
1.	Plant-6	3TIC3-4500	Absorption Reactor Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
2.	Plant-5	3TIC3-4780A	Hydrogenating Reactor Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
3.	Plant-5	3TIC3-4780B	Hydrogenating Reactor Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
4.	Plant-5	3TIC1-4712	Anilox-9 Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
5.	Plant-5	3TIC2-4842	Solvent Recovery Plant Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
6.	Plant-5	3TIC2-4716	Grade Compt. Plant Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
7.	Plant-5	3TIC3-4840	Purification Plant Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
8.	Plant-5	3TIC1-4720	Anilox-10 Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-
9.	Plant-5	3TT3-4855	Tol. Recovery Plant Temp CV.	ok	ok	ok	ok	17/1/2023	Sanjit	Signed	-

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-3	32	11

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Node	Stream	Sr. No.	Page Ref. No
Node 3	Stream-1	37	12
Node 4	Stream-1	45	

12

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Node	Stream	Sr. No.	Page Ref. No
Node 3	Stream-1	38	13

13




CM-07 FETTING PUMP
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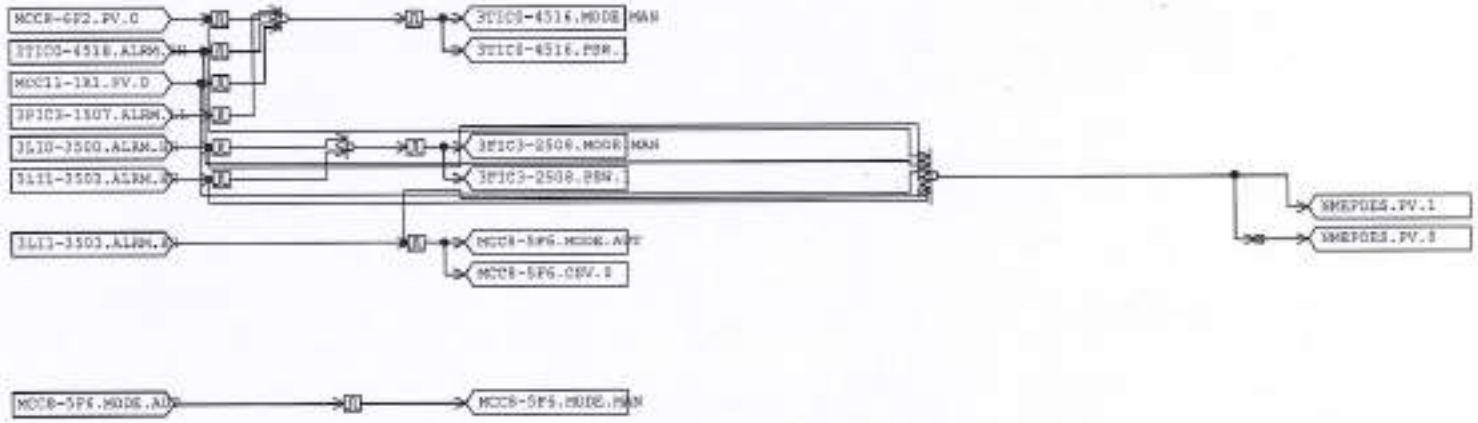
Node	Stream	Sr. No.	Page Ref. No
Node 3	Stream-2	40	14
	Stream-2	41	
	Stream-2	42	
	Stream-2	44	

14

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Logic Chart :MMEPDESORPTION

Start Timing	Periodic Execution Type(T)
Scan Period	Basic Scan
Control Period	1
Control Phase	0
Execution Order	Matrix order
Direct Direction Wiring	————
Reverse Direction Wiring	- - - - - -



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2264

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15



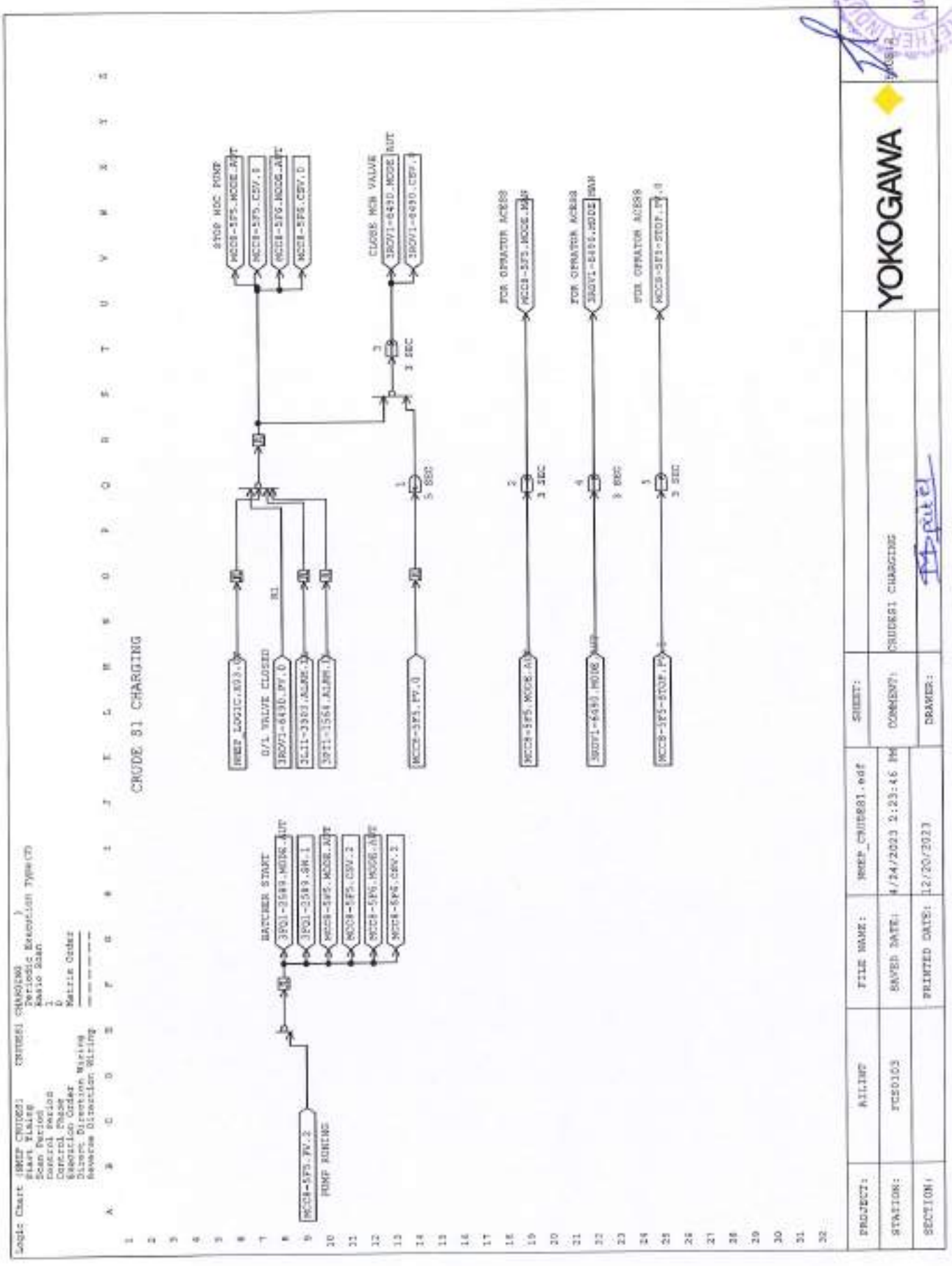


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Node	Stream	Sr. No.	Page Ref. No
Node 4	Stream-1	46 48	16

16

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Logic Chart (BREP CRUDE81 CRUDE81 CHARGING) 1
Periodic Execution Type(T)
Basic Scan
1
0
Matrix Order
CRUDE 81 CHARGING
BATCHER START
PUMP RUNING
SHOP NOC PUMP
O/L VALVE CLOSED
CLOSE MOV VALVE
3 SEC
5 SEC
FOR OPERATOR ACKGS
PROJECT: AILIAN
STATION: FCS0103
SECTION:
FILE NAME: BREP_CRUDE81.edf
SAVED DATE: 4/24/2023 2:23:46 PM
PRINTED DATE: 12/20/2023
SHEET:
COMMENT: CRUDE81 CHARGING
DRAWER:
YOKOGAWA

Node	Stream	Sr. No.	Page Ref. No
Node 4	Stream-2	50	17
		51	
		52	
		54	

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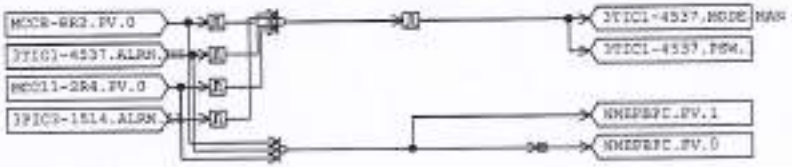
Logic Chart NMEPBPCP

Start Timing	Periodic Execution Type(T)
Scan Period	Basic Scan
Control Period	1
Control Phase	0
Execution Order	Matrix Order
Direct Direction Wiring	
Reverse Direction Wiring	

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

BPCP DISTILLATION



PROJECT:	AILINT	FILE NAME:	NMEPBPCP.adf	SHEET:		YOKOGAWA
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2270

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Node	Stream	Sr. No.	Page Ref. No
Node 1	Stream-2	25	18

18

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FLOWTECH
LPM NITROGEN GAS ATPR-3KG/CM2 PGH231847
50
40
30
20
10
5

HAZOP STUDY REPORT OF

EO Tankfarm

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

DECEMER 2023

aether
elementally innovative



NEXA
Process Safety Engineers

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HAZOP STUDY REPORT OF

EO Tankfarm

DECMEBR 2023

By

NEXA PROCESS SAFETY ENGINEERS

NEXA
Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

18/12/2023

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Project EO tanks.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for EO tanks Project.
It has 1 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	EO Storage Tanks (110ST-001& 110ST-002)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of

identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the

participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

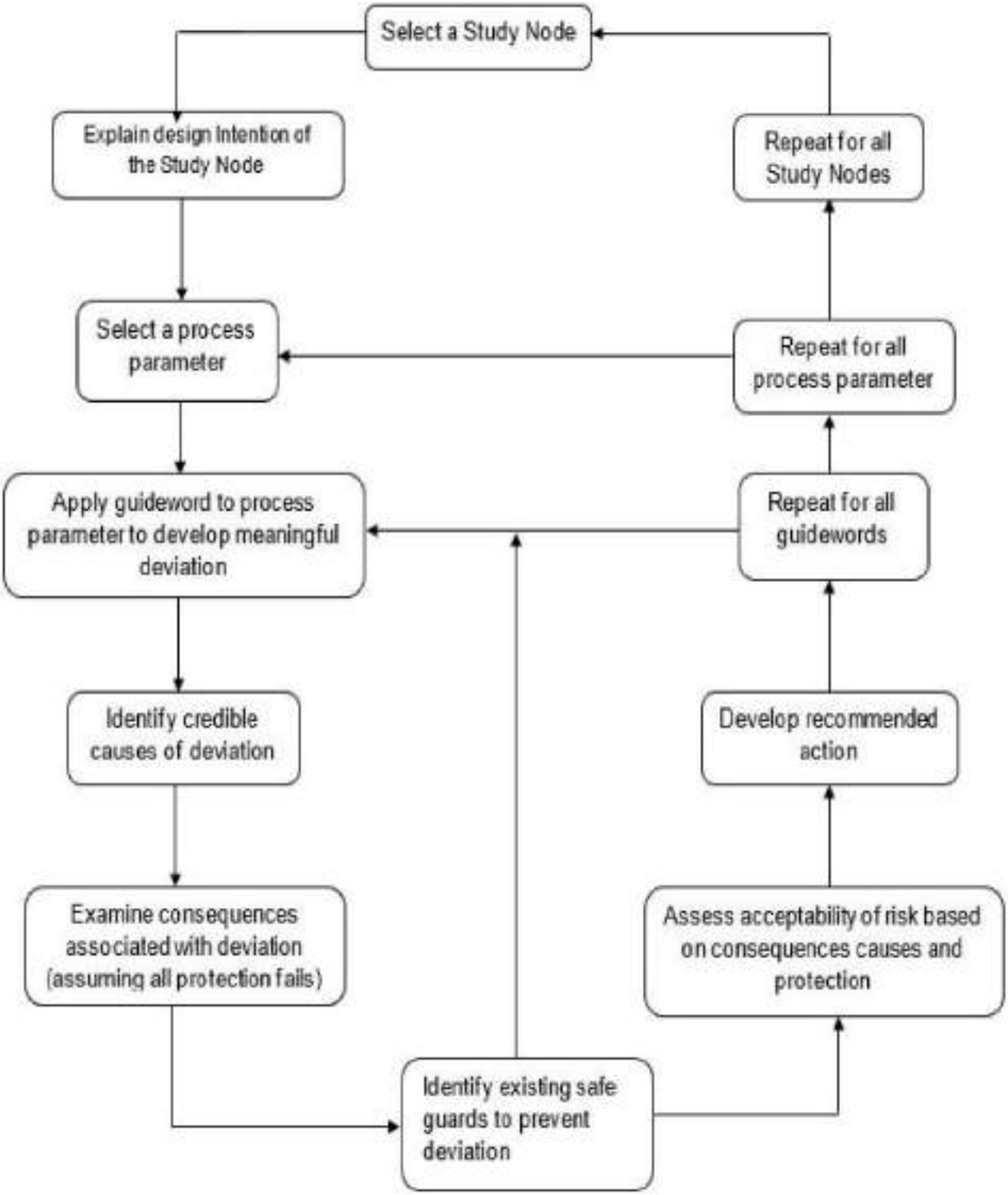
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	1- 4	**Acceptable:**But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	5- 12	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	15- 25	**Unacceptable:**Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work / Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to alert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL 3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)	or work stoppage (>24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3 –Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4 Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5 5-100kg;	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum / vent / process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5 Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs 50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	Available at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.....	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.....	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

"...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

Node 1: EO Storage Tanks (110ST-001& 110ST-002)						
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	Recommendations
1	Level	Low	Tank leakage	Fire & Explosion hazard	1. EO detectors are available to detect leakages with high and high alarms on DCS. 2. PT is available to monitor pressure in the tank with alarms. 3. Pressure test is being carried out before starting batch. 4. 300 class flanges are used. 5. Sprinkler system is provided in the tankfarm. 6. Fire hydrant points are available. 7. All electrical installations in the tankfarm are as per HAC classification. 8. Tank pressure testing is performed as per PM schedule. 9. LI is available in the tank to monitor the level with alarms and flash alarms.	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as "Intolerable" "Substantial" "Moderate" "Tolerable"" Trivial".

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or "improved operability and maintainability" categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of Ethylene Oxide Storage Tanks												
Title : EO Storage Tanks (110ST-001& 110ST-002)									Plant Name: 8203, Date-18/12/2023			
Node		Node Description : EO Storage Tanks (110ST-001& 110ST-002)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
1	Quantity/Flow	No/Less	Not Applicable									
		High/More	Not Applicable									
		Reverse	Not Applicable									
		Mis-directed flow	Not Applicable									
2	Pressure	Low	line leakage/Flange leakage/Tank Leakage	Fire & Explosion hazard	1. EO detectors are available to detect leakages with high and high alarms on DCS. 2. PT is available to monitor pressure in the tank with alarms. 3. Pressure test is being carried out before starting batch.	3	3	9	1. Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	2	3	6

					4. 300 class flanges are used. 5. Sprinkler system is provided in the tankfarm. 6. Fire hydrant points are available. 7. All electrical installations in the tankfarm are as per HAC classification. 8. Tank pressure testing is performed as per PM schedule.							
		High	N2 line manual valve pass	Tank may pressurise	1. EO storage tank design pressure is 6 bar. 2. PT is available in the tankswith HH alarms and and flash alarms. 3. 1 number of RD & PSV in series and 1 seperate PSV is available to prevent overpressurisation in the tank which is connected to water catch pot 4. Sprinkler system is provided in the tankfarm. 5. Fire hydrant	3	3	9				

					points are available. 6. All electrical installations in the H2 yard are as per HAC classification. 7. N2 PRV (1.5 bar) is available to reduce overpressurisation due to nitrogen pressure.							
			Vent line valve closed while filling material		1. CV is available in the charging line and interlock is available to close CV at HH pressure of tank.	3	3	9				
			Loss of cooling in jacket		1. Brine supply isprovided in the jacket with TI and alarms and flash alarms. 2. Interlock is available to open brine supply line ROV at HH temperature of tank.	2	3	6				
3	Temperature	Low	No HSE Hazard									

		High	Loss of cooling in jacket	Temperature & pressure rise may possible in the tank	1. TT is available in the tankswith HH alarms and and flash alarms. 2. 1 number of RD & PSV in series and 1 seperate PSV is available to prevent overpressurisation in the tank which is connected to water catch pot 3. Sprinkler system is provided in the tankfarm. 4. Fire hydrant points are available. 5. All electrical installations in the H2 yard are as per HAC classification. 6. Interlock is available to close discharge line CV and incoming line CV at HH temperature of the tank. 7. ROV is also available in the brine supply line.	3	3	9				

4	Level	Low	Tank leakage	Fire & Explosion hazard	1. EO detectors are available to detect leakages with high and high alarms on DCS. 2. PT is available to monitor pressure in the tank with alarms. 3. Pressure test is being carried out before starting batch. 4. 300 class flanges are used. 5. Sprinkler system is provided in the tankfarm. 6. Fire hydrant points are available. 7. All electrical installations in the tankfarm are as per HAC classification. 8. Tank pressure testing is performed as per PM schedule. 9. LI is available in the tank to monitor the level with alarms and flash alarms.	3	3	9	1. Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	2	3	6

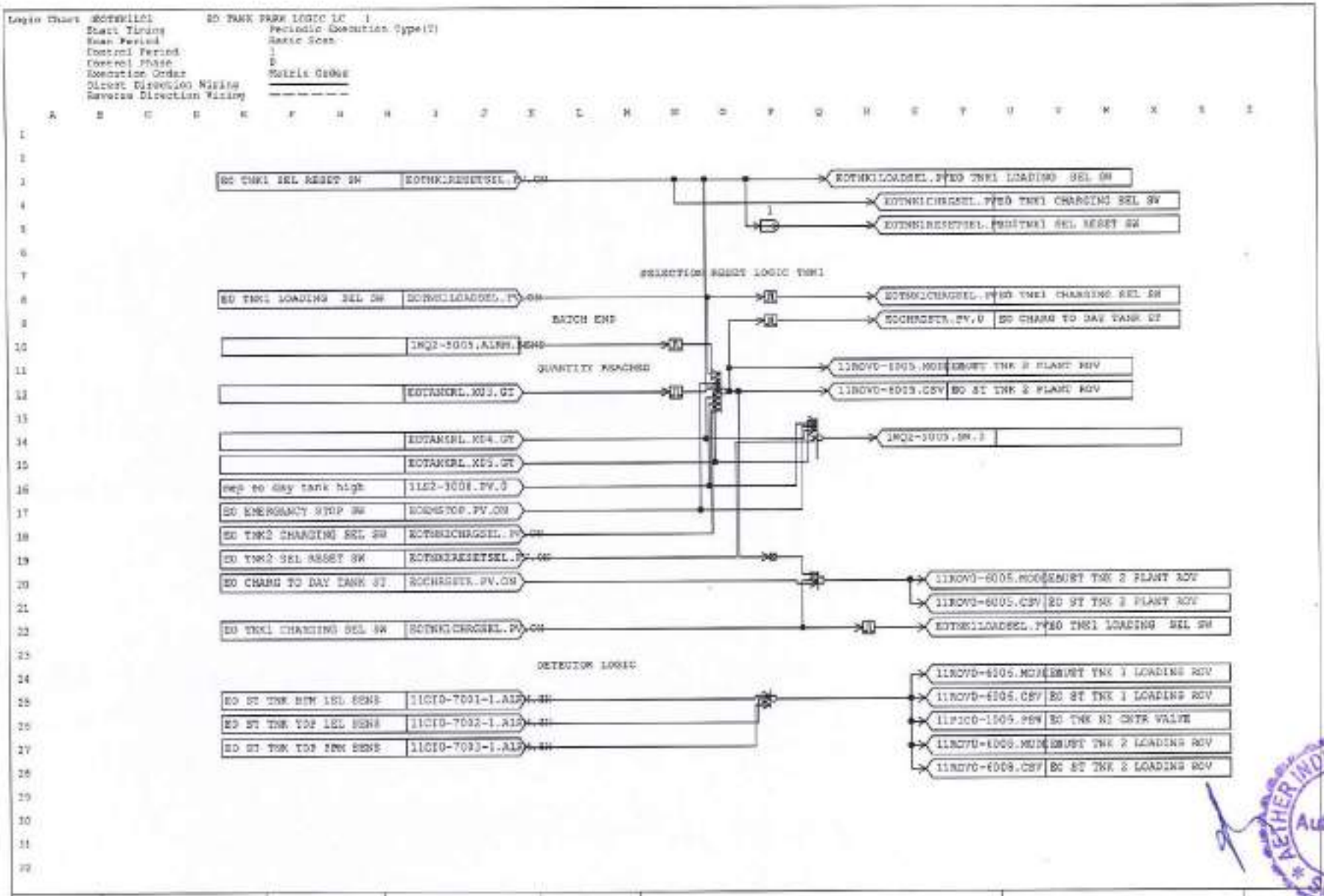
		High	More material filled (Human Error)		1. Interlock is available to close incoming line CV and ROV at HH value of LI. 2. Flash alarm is also available on LI HH alarms. 3. Trained manpower will operate and verification of level is performed before filling material.	3	4	12				
5	Others	Static charge	-	Fire & Explosion hazard	1. Earthing jumpers are provided in lines. 2. Double earthing is provided to the tank. 3. Earth rite system with hooter is provided to maintain earthing continuity while filling EO. 3. Earthing continuity testing is performed before start-up. 4. Nitrogen padding is performed in the both the tanks to eliminate air ingress	3	4	12				

					in the tank.							
		Instrument Air Failure	Air compressor failure	Tank may pressurise	All instruments air fail safe position is air fail to close and brine supply line ROV is air fail to open.	4	1	4				
		Power failure	GEB power failure	Tank may pressurise	DG backup provision is available.	2	2	4				
		DCS Failure	Battery bank failure	Tank may pressurise	Redundant battery bank is available & PM is performed as per schedule.	2	2	4				
		Agitation	Not Applicable									

|| END OF THE REPORT ||

EO HAZOP Report Recommendations Status					
Node 1	Sr. No.	Recommendations			
		EO Storage Tanks (110ST-001& 110ST-002)	Status	Action Taken	Page Ref. No.
	1	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of EO detector.	Completed	Implemented in DCS	1

ATHER INDUSTRIES LIMITED
Authorised
* SURAT *



AETHER INDUSTRIES LIMITED * SURAT * Authorised

2305

HAZOP STUDY REPORT OF

IB Tankfarm

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

DECEMER 2023

aether
elementally innovative



NEXA
Process Safety Engineers

2307

AETHER INDUSTRIES LTD.,

SURAT

aether
elementally innovative

HAZOP STUDY REPORT OF

IB Tankfarm

DECMEBR 2023

By

NEXA PROCESS SAFETY ENGINEERS

NEXA
Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

18/12/2023

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Project IB Tanks.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for IB Tanks Project.
It has1 node as per following:

NODE NO.	NODE DESCRIPTION
1.	IB Storage Tanks (110ST-003& 110ST-004)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of

identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the

participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

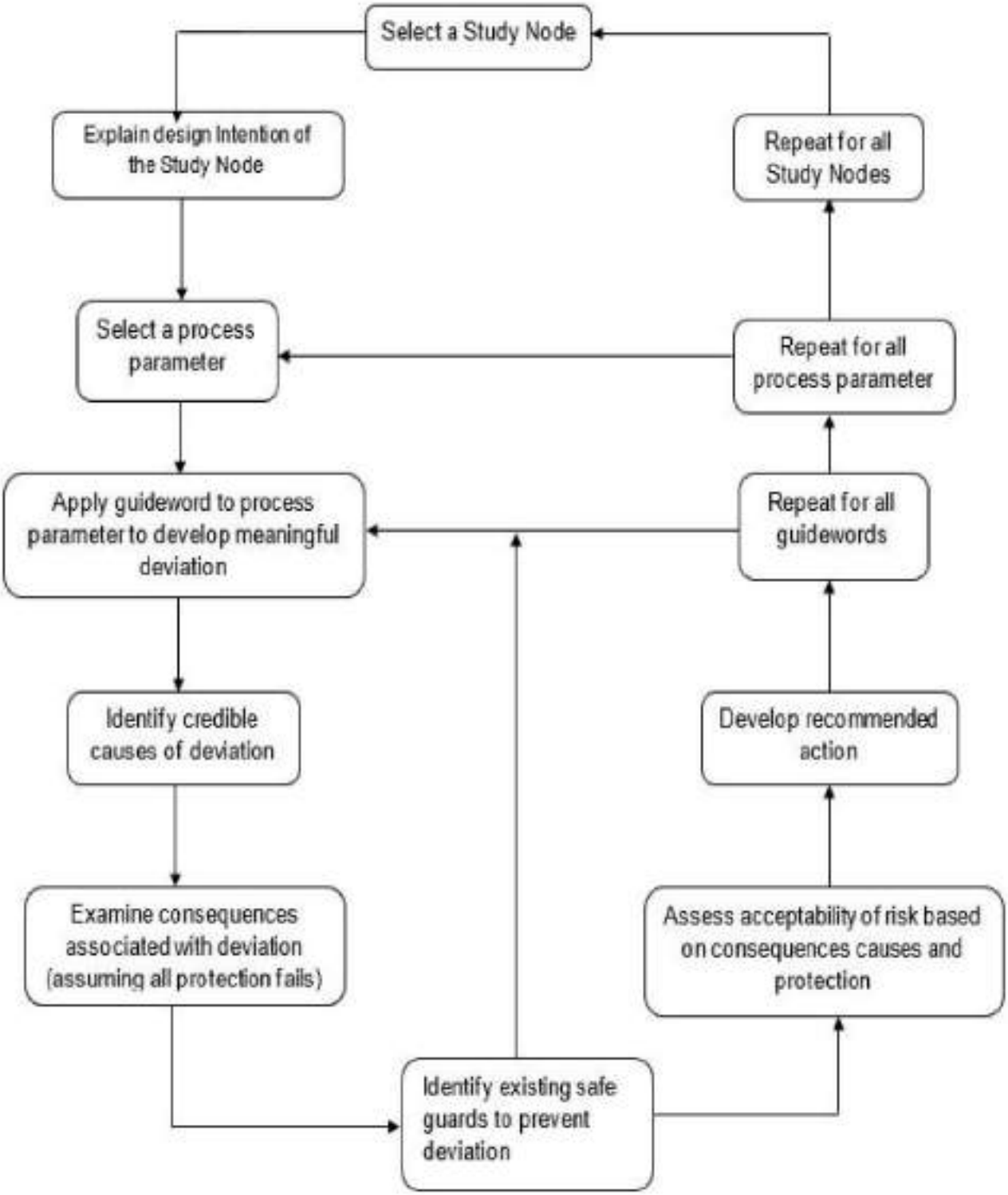
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	1- 4	**Acceptable:**But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	5- 12	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	15- 25	**Unacceptable:**Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work / Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL 3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)	or work stoppage (>24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3 –Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4 Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-3-100kg.	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum / vent / process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5 Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs 50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	Available at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.....	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.....	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode

requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

"...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarized as below;

Node 1: IB Storage Tanks (110ST-003& 110ST-004)						
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	Recommendations
1	Level	Low	Tank Bottom valve left open/pass	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is provided at bottom of the tank. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification. 5.Fire water sprinkler is installed in IB tank area. 6.Spillage kit to be provide the near by area. 7.LI is available to monitor the level of storage tank. 8.LEL sensor is installed on IB tank area with alarm.	Recommended to provide interlock to stop incoming line ROV & closed the transferring line pump at HH alarm value of LEL detector of IB tank.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as "Intolerable" "Substantial" "Moderate" "Tolerable"" Trivial".

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or "improved operability and maintainability" categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of IB Storage Tanks												
Title : IB Storage Tanks (110ST-003& 110ST-004)									Plant Name: S263 Date : 18/12/2023			
Node		Node Description : IB storage tank(110ST-003 & 110ST-004)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
1	Pressure	Low pressure	Human error(Vapour balance line valve is not open during transfer to plant)	Tank may implode	1.PT is available on tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up before startup.	3	3	9				

		High pressure	N2 line manual valve passed	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.PG is also installed on the tank. 3.RD with PSV in series connection is provided in the tank for overpressure protection. 4.Separate PSV is also provided in the tank. 5.Vent line of the RD & PSV is given in separate pot. 6.Flash alarm is provided on high high value of PT of the tank. 7.N2 line maximum pressure is 3kg/cm2 which is higher than design pressure.	3	3	9				
			Human error(Vapour balance line valve is not open during tanker unloading)		1.PT is available on tank with high and high high alarm. 2.Tank is designfor upto 6 bar pressure . 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Interlock is provided to stop the IB tanker unloading pump at HH value of PT of the tank and same time translering line ROV to be closed.	3	3	9				

2	Temperature	Low	No probable cause		TI is available on tank with low and low low alarm.							
		High	No probable cause		TI is available on tank with high and high high alarm.							
3	Level	Low	Tank Bottom valve left open/pass	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is provided at bottom of the tank. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification. 5.Fire water sprinkler is installed in IB tank area. 6.Spillage kit to be provide the near by area. 7.LI is available to monitor the level of storage tank. 8.LEL sensor is installed on IB tank area with alarm.	3	3	9	1. Recommended to provide interlock to stop incoming line ROV & closed the transfering line pump at HH alarm value of LEL detector of IB tank.	3	3	9
			Tank body leakage		PM is performed before start-up and record is maintained.	3	3	9				

		High	LI malfunctioning during tanker unloading	Tank may overflow	1.PM of critical instrument is performed as per predefine schedule.	3	3	9				
			Human error(more quantity is filled in tank)		1.Trained manpower is deputed for operation &Tanker quantity is verified before unloading. 2.LI is available on tank with high and high high alarm. 3.Interlock is provided to stop the IB tanker unloading pump &transfering line ROV at HH value of LI of IB tank.	3	3	9				

4	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the IB supply line. 2. Double earthing is provided to IB tank. 3. Earth rite system is provided to IB tanker during unloading . 4. Hooter is provided in the H2 PRS yard for alarming in case of earthing continuity breaks. 5.Earthing continuity testing is performed before start-up. 4. Nitrogen padding is performed in the both the tanks to eliminate air ingress in the tank.	3	3	9				
		Instrument Air Failure	Air compressor failure	Tank may pressurize	1.All instruments air fail safe position is air fail to close. 2.Interlock is provided to stop the IB tanker unloading pump in case of transfering line ROV is closed.	4	3	12				
		Power failure	GEB power failure	No HSE hazard/Process Delay	DG backup provision is available.	2	1	2				

		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	2	1	2				
		Agitation	No probable cause									

|| END OF THE REPORT ||

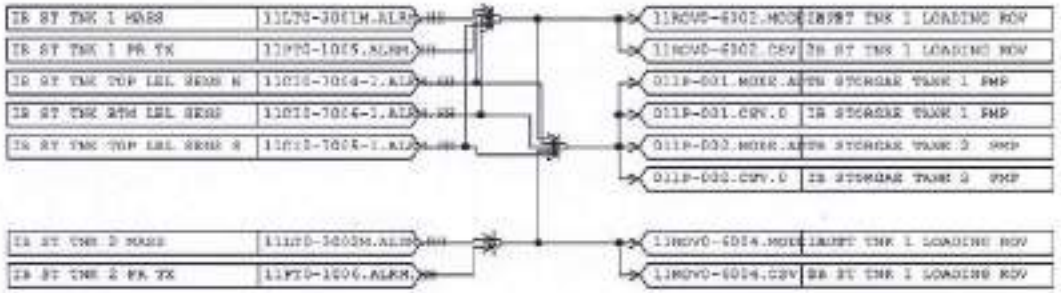
IB HAZOP Report Recommendations Status					
Node 1	Sr. No.	Recommendations			
		IB Storage Tanks (110ST-003& 110ST-004)	Status	Action Taken	Page Ref. No.
	1	Recommended to provide interlock to stop incoming line CV & ROV at HH alarm value of IB detector.	Completed	Implemented in DCS	1

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Logic Chart [IELC SO TANK FARM LOGIC LC]

Start Timing: Periodic Execution Type(Y)
Scan Period: Basic Scan
Control Period: 1
Control Phase: 0
Execution Order: Ratio Order
Direct Direction Wiring: ---------
Reverse Direction Wiring: ---------

IB STORAGE TANK 1 LOGIC



IB STORAGE TANK 2 LOGIC

PROJECT:	AILIN7	FILE NAME:	IELC.edf	SHEET:		YOKOGAWA	PAGE:2
STATION:	FCS0101	SAVED DATE:	12/20/2023 8:24:33 PM	COMMENT:	SO TANK FARM LOGIC LC		
SECTION:		PRINTED DATE:	12/20/2023	DRAWER:			

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2338

HAZOP STUDY REPORT OF MEP PROJECT

M/S AETHER INDUSTRIES LTD.,

SACHIN, SURAT

DECEMBER 2023

aether
elementally innovative



NEXA
Process Safety Engineers

2339

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

HAZOP STUDY REPORT OF

MEP PROJECT

DECEMBER 2023

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel ad his team and all other Head of the departments of respective plant for speedy completion of this report.



Surat **Proprietor**

12-12-2023 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation.
- To identify significant operating or quality problems.
- To identify practical problems associated with maintenance operation.

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for MEP project.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management. The participants had a significant amount of experience in the Process Safety

Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well known as well as the required control measures to reduce risk to acceptable levels.

During the study, Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 Scope

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for MEP project. it was divided in to following 8 nodes as below:

NODE NO.	NODE DESCRIPTION
1.	Grignard reactor (042RT-073)
2.	EO coupling reactor(042RT-075)
3.	Quenching reactor (041RT-077)
4.	Distillation Column (041CM-040)
5.	041CM-042 (Continuous Toluene Distillation Column)
6.	041CM-043 (Low Boiler Distillation Column)
7.	041CM-044 (Flash MEP Distillation Column)
8.	041CM-045 (Batch MEP Distillation Column)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 Methodology

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.

9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Annexure 01 - INCIDENT SEVERITY CLASSIFICATION
(Refer Annexure 1 of Doc. No.: SHE/P/SAF/04 Rev. No.: 02, Procedure for Incident Classification, Reporting and Investigation)

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response Any Fire in areas other than mentioned as Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)	or work stoppage (>24 hours) Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<3litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS MM 1-2 ≤0.5kg GHS MM 3-5 ≤5kg Other GHS ≤5kg	GHS MM 1-2 0.5-5kg; GHS MM 3-5=5-100kg,	GHS MM 1-2 >5kg GHS MM 3-5 >100kg Other GHS >100kg

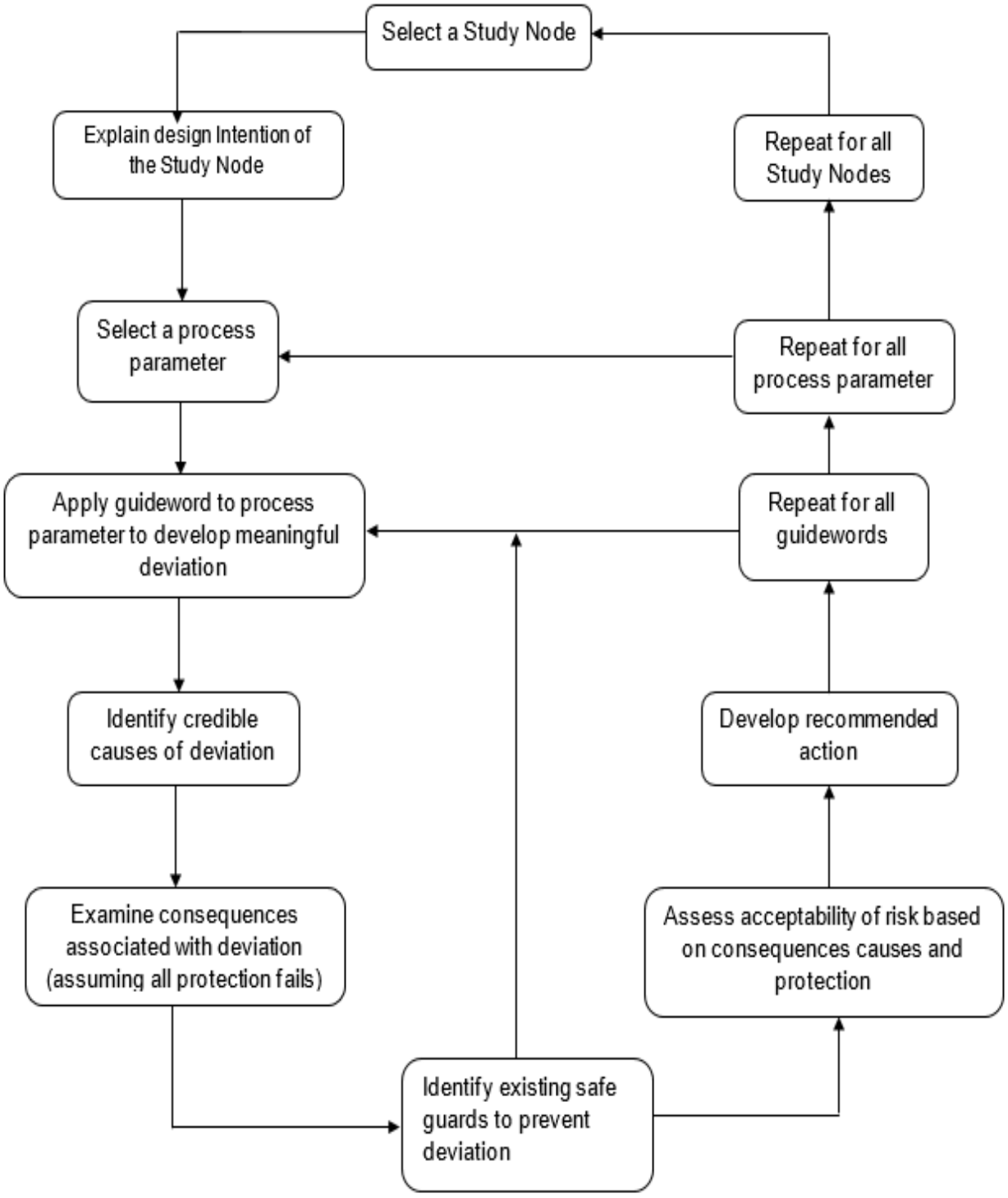
Annexure 01 - INCIDENT SEVERITY CLASSIFICATION
(Refer Annexure 1 of Doc. No.: SHE/P/SAF/04 Rev. No.: 02, Procedure for Incident Classification, Reporting and Investigation)

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work / Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration, Explosion Process safety event resulting in facility evacuation, shelter in place

Annexure 01 - INCIDENT SEVERITY CLASSIFICATION
(Refer Annexure 1 of Doc. No.: SHE/P/SAF/04 Rev. No.: 02, Procedure for Incident Classification, Reporting and Investigation)

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum / vent / process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS <100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID / SOPS / MSDS	Provided at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs and enter the necessary data (as much as possible) in the HAZOP work sheet.
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP.
- Incorporate comments and issue the Final Report, within ten (10) working

days of the completion of the plant HAZOP.

- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S G Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S G Patel	HAZOP Leaders	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal- Electrical Mr. Smit Desai- Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team Members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION/SPECIFIC REMARKS

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop...” Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendations are summarised as below:

Sr. No.	Recommendations
Node 1	**Grignard reactor (042RT-073)**
Stream-1	**Mg turnings charging into grignard reactor(042RT-073)**
	1. Spill kit to be provided to contain spillage. 2. Area barrication to be done to restrict man movement during charging.
Stream-2	**Heating in grignard reactor (042RT-073)**
	1. Flash alarm to be provide on HH value of PT of the reactor.
	1.Vent line/vapour line valve should be always locked open condition with tag.
	1.Flash alarm is provided on HH value of RTD of the reactor.
	1.TCV bypass valve should be locked closed condition with tagging.
Stream-3	**PCP charging in the reactor (042RT-073)**
	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.
	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.
Stream-4	**THF charging in the reactor (042RT-073)**
	Spill kit to be provided in the nearby area to contain spillage.
	1. Vent line valve should be locked open.
	1. Vent line valve should be locked open condition with tagging. 2. Interlock to be provided to stop charging pump at HH pressure of the reactor. 3. Flash alarm to be provided at HH pressure of the reactor.
Node 2	**Node Description : EO coupling reactor(042RT-075)**
Stream-1	**Grignard mass (S-2) transferring in EO coupling reactor(042RT-075) by N2 pressure**
	1.Vent line/vapour line valve should be always locked open condition with tag.
	1. Flash alarm to be provide on HH value of RTD of the reactor.
	1.TCV bypass valve should be locked closed condition with tagging. 2. Interlock to be provided to close steam line TCV at HH temperature of the reactor.
Stream-2	**Toluene charging in EO coupling reactor (042RT-075)**
	Spill kit to be provided in the nearby area to contain spillage.
	1. Vent line valve should be locked open.
	1. Vent line valve should be locked open condition with tagging. 2. Interlock to be provided to stop charging pump at HH pressure of the reactor. 3. Flash alarm to be provided at HH pressure of the reactor.
Stream-3	**EO addition in EO coupling reactor (042RT-075) from EO day tank (2KL)**
	1. Flash alarm to be provided at HH temperature of reactor TI. 2. Interlock to be provided to open TMBS line ROV at HH temperature of reactor
	1. Vent line valve should be critical locked open with tag. 2. Interlock to be provided to close addition line CV at HH pressure of the reactor.
	1. Flash alarm to be provided at HH pressure of the reactor.
	Flash alarm to be provide on HH value of RTD of the reactor.

Sr. No.	Recommendations
	1.TCV bypass valve should be locked closed condition with tagging.
Node 3	**Node Description : Quenching reactor (041RT-077)**
Stream-1	**Reaction mass transfer to quenching reactor (041RT-077) by N2 pressure**
	Flash alarm to be provide at HH pressure of reactor.
	1.Vent line/vapour line valve should be always locked open condition with tag.
	Flash alarm to be provide on HH value of RTD of the reactor.
	1.TCV bypass valve should be locked closed condition with tagging.
Stream-2	**20% H2SO4 charging in quenching reactor (041RT-077)**
	1. Vent line valve should be locked open with tagging.
	Flash alarm to be provided at HH temperature of reactor TI.
	1. Vent line valve should be locked open. 2. Interlock to be provided to close addition line CV at HH pressure of the reactor.
	Flash alarm to be provide at HH temperature of reactor TI.
Stream-3	**Water charging in quenching reactor (041RT-077)**
	1. Vent line valve should be locked open with tagging.
Node 4	**Node Description : Distillation Column (041CM-040)**
Stream-1	**Continuous feeding from storage tank(40ST-0129) to distillation column(041CM-040) through feeding pump(040TP-265A/B)**
	1.Pump running indication to be provide on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.

Sr. No.	Recommendations
	1.Flame arrestor PM to be carried out as per define schedule.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop. and also bottom collection CV to be closed.
	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.
	1.TCV bypass valve should be locked closed condition with tagging.
	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump, Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
	1.CV stroke testing to be carried out as per defined PM schedule.
Stream-2	**Continuous distillation in distillation column (041CM-040)**
	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.
	1.Flame arrestor PM to be carried out as per define schedule.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.
	1.TCV bypass valve should be locked closed condition with tagging.
	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed.

Sr. No.	Recommendations
	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
	1.CV stroke testing to be carried out as per defined PM schedule.
	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.
Stream-3	**Top collection in receiver(043TK-208)**
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1. Flow meter PM to be done periodically.
	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.Recommend to provide interlock to stop the XV of transferring line from 1KL to 25KL at HH value of PT of the 25KL tank. 3. Flash alarm to be provided at HH pressure of tank.
	1.Flame arrestor PM to be performed before start up.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
Stream-4	**Bottom withdrawal in tank (040ST-131)**
	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdraw pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Production supervisor need to confirm valve position before start operation.
	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1. Flow meter PM to be done periodically.
	1.Interlock to be provided that at HH value of LI of storage tank bottom collection CV to be closed.

Sr. No.	Recommendations
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.At HH value of PT of tank collection line CV to be closed. 3, Flash alarm to be provided in at the HH alarm of PT.
	1.Flame arrestor PM to be performed before start up.
	Recommend to provide blind or remove Oil line connection in jacket of the receiver.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
Node 5	**Node Description : 041CM-042 (Continuous Toluene Distillation Column)**
Stream-1	**Continuous feeding from storage tank(40ST-0137) to distillation column(041CM-042) through feeding pump(040TP-277A/B)**
	1.Pump running indication to be provide on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2	**Continuous distillation in distillation column (041CM-042)**
	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.
	1.Flame arrestor PM to be carried out as per define schedule.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column.

Sr. No.	Recommendations
	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.
	1.TCV bypass valve should be locked closed condition with tagging.
	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
	1.CV stroke testing to be carried out as per defined PM schedule.
	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.
Stream-3	**Top collection in receiver(043TK-215)**
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.Recommend to provide interlock to stop the XV of transferring line from 1KL to 6KL at HH value of PT of the 6KL tank. 3. Flash alarm to be provided at HH pressure of tank.
	1.Flame arrestor PM to be performed before start up.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
Stream-4	**Bottom withdrawal in tank (040TK-217)**
	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Production supervisor need to confirm valve position before start operation.
	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1. Flow meter PM to be done periodically.

Sr. No.	Recommendations
	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.At HH value of PT of tank collection line CV to be closed. 3, Flash alarm to be provided in at the HH alarm of PT.
	1.Flame arrestor PM to be performed before start up.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
Node 6	**Node Description : 041CM-043 (Low Boiler Distillation Column)**
Stream-1	**Continuous feeding from storage tank(40ST-0129) to distillation column(041CM-040) through feeding pump(040TP-265A/B)**
	1.Pump running indication to be provide on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2	**Continuous distillation in distillation column (041CM-043)**
	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column.

Sr. No.	Recommendations
	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.
	1.TCV bypass valve should be locked closed condition with tagging.
	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
	1.CV stroke testing to be carried out as per defined PM schedule.
	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.
Stream-3	**Top collection in receiver(043TK-218)**
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.
	1.Flame arrestor PM to be performed before start up.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
Stream-4	**Bottom withdrawal in tank (040TK-219)**
	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Production supervisor need to confirm valve position before start operation.
	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1. Flow meter PM to be done periodically.

Sr. No.	Recommendations
	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Node 7	**Node Description : 041CM-044 (Flash MEP Distillation Column)**
Stream-1	**Continuous feeding from receiver(40TK-219) to distillation column(041CM-044) through feeding pump (040TP-281A/B)**
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2	**Continuous distillation in distillation column (041CM-044)**
	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.TCV stroke testing to be carried out as per define schedule.

Sr. No.	Recommendations
	2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.
	1.TCV bypass valve should be locked closed condition with tagging.
	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
	1.CV stroke testing to be carried out as per defined PM schedule.
	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.
Stream-3	**Top collection in receiver(043TK-220)**
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.
	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.
	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
	1. Flow meter PM to be done periodically.
	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
	1.Double valve is available to prevent valve passing/leakage.

Sr. No.	Recommendations
Node 8	**Node Description : 041CM-045 (Batch MEP Distillation Column)**
Stream-1	**Pure MEP distillation in 041CM-045**
	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.
	1.PM of TCV is to be performed as per predefined schedule.
	1.TCV bypass valve should be locked closed condition with tagging.
	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.
	1.TCV of Oil line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.
Stream-2	**Collection of pure MEP in receiver 042TK-224A**
	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil PCV to be closed. 2.At HH temperature of final vent line Oil PCV to be closed.
	1.Flash alarm to be provide on high high value of LI of receiver.
	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil PCV to be closed.
	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of receiver.
	1.Flame arrestor PM to be performed before start up.
	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved

operability and maintainability" categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please refer to column entitled "Action Tracking" in the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for **M/s Aether Industries Ltd., Surat**.. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with **M/s Aether Industries Ltd., Surat**.

APPENDIX-1: HAZOP MINUTES

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 1		Node Description : Grignard reactor (042RT-073)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Mg turnings charging into grignard reactor(042RT-073)									
1	Quantity/Flow	No/Less	Human Error(Less Quantity charged)	No HSE hazard	Fixed quantity of material will be issued from the store batchwise.	2	2	4				
			Wrong measured quantity supplied from store department	No HSE hazard	Issue slip & physical verification of quantity is done before start-up.	2	2	4				
			Human Error (Spillage)	No HSE hazard	1. Full body air supply suit is wear by person during charging. 2. Trained manpower will be deputed for this activity. 3. Hopper with valve will be used for charging.	3	1	3	1. Spill kit to be provided to contain spillage. 2. Area barrication to be done to restrict man movement during charging.	2	1	2
		High/More	Human Error(More Quantity charged)	No HSE hazard	1. Fixed quantity of material will be issued from the store batchwise.	3	1	3				

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	Node Description : Grignard reactor (042RT-073)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Wrong measured quantity supplied from store department		2. Issue slip & physical verification of quantity is done before start-up. 3. Trained manpower will performed the activity.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	Not Applicable									
		High	Not Applicable									
3	Temperature	Low	Not Applicable									
		High	Not Applicable									
4	Level	Low	Not Applicable									
		High	Not Applicable									
5	Composition	Other than	Not Applicable									
6	Other	Static Electricity	Not Applicable									
		Instrument Air failure	Not Applicable	No HSE hazard								
		Power Failure	Not Applicable	No HSE hazard								
		DCS Failure	Not Applicable	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 1		**Node Description : Grignard reactor (042RT-073)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-2		**Heating in grignard reactor (042RT-073)**										
7	Quantity/Flow	No/Less	No probable cause	-	-				-			
		High/More	No probable cause	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
8	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	Reactor may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Ventline is provided in reactor & ensure before startup that valve is open condition. 5.RD is available in the reactor which is connected to catchpot. 6.PT is available in reactor with high and high high alarm. 7. RD is provided in the reactor which is	3	4	12	1. Flash alarm to be provide on HH value of PT of the reactor.	3	4	8

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	Node Description : Grignard reactor (042RT-073)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					connected with catch pot.							
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
			Human error(Manual ventline/vapour line valve is not open of reactor)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor. 3.Interlock is provided to closed the steam TCV at HH value of PT of the reactor.	3	4	12	1.Vent line/vapour line valve should be always locked open condition with tag.	2	4	8
9	Temperature	Low	Human error(cooling water supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	Node Description : Grignard reactor (042RT-073)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.Flash alarm is provided on HH value of RTD of the reactor.	3	4	12
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 2.Trained manpower is deputed for DCS operation. 3.Interlock is provided to closed the steam TCV at HH value of TI of reactor. 4. upper limit of TCV set value is freeze as per process requirement.	3	4	12				
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line.	3	4	12				
10	Level	Low	No probable cause									

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	Node Description : Grignard reactor (042RT-073)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Jacket puncture of the reactor	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of jacket is performed periodically.	3	3	9				
11	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	3	9				
12	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is to be air fail to close.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 1		**Node Description : Grignard reactor (042RT-073)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible in reactor	1.No load tripping is provided on agitator. 2.Steam TCV is closed in case of agitator stop/trip.	3	4	12				
Stream-3		**PCP charging in the reactor (042RT-073)**									
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of reactor not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start.l. 2.Flow meter is available in transferring line. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup.	3	1	3	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.			
			Human error (manual valve of reactor not opened).	No HSE hazard/Process Delay								
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Low level in storage tank	No HSE hazard/Process Delay	1.Flow meter is available in transferring line .	3	1	3				

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	Node Description : Grignard reactor (042RT-073)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Line/Valve chocked	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line. 3.Flange guard is provided in transferring line. 4.Line pressure test is performed before startup. 5.Jacketed line is provided to prevent line chocking.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used to prevent gasket leakage. 4.All jacketed manual valve to be provided.	2	3	6
			Flow meter chocked	Line may pressurise and lead to spillage /health hazard & fire hazard	1.Jacked flow meter is provided to prevent chocking.	3	3	9				
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vapour line is connected with condenser or no open vent in reactor.so, no chances of overflow. 3. Batchwise RM is taken in the day tank so more charging not possible.	2	3	6				
		Reverse	No probable cause									
		Mis-	No probable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 1		Node Description : Grignard reactor (042RT-073)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		directed flow	cause									
14	Pressure	Low pressure in reactor	1. Human error (Vent line valve not opened) 2.vent line chocked	Storage tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for operation. 4.Storage tank is design for full vacuum to 6 bar.	2	2	4				
		High	Human Error (During charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar.	3	1	3				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Refer low flow									
		High	Refer high flow									
17	Composition	Other than	No probable cause									
18	Others	Static	Not Applicable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 1		**Node Description : Grignard reactor (042RT-073)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Electricity										
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-4		**THF charging in the reactor (042RT-073)**										
19	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	2	4				
			Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.							
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by	3	3	9	Spill kit to be provided in the nearby area to contain spillage.	2	3	6

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	Node Description : Grignard reactor (042RT-073)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area. 6.All electrical equipment are flameproof in near by area.							
			No level in tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	1	3				
			Human error (Vent line valve not opened)	Reactor may pressurise	No existing safeguard	3	4	12	1. Vent line valve should be locked open.	2	4	8
			Vent line flame arrestor chocked		1. Flame arrestor PM is performed as per PM schedule. 2. Choking property material is not available.	2	4	8				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1. Upper limit is freezed in the totaliser to prevent more charging of toluene.	2	2	4				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
20	Pressure	Low	No probable cause									

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	**Node Description : Grignard reactor (042RT-073)**	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms.	3	4	12	1. Vent line valve should be locked open condition with tagging. 2. Interlock to be provided to stop charging pump at HH pressure of the reactor. 3. Flash alarm to be provided at HH pressure of the reactor.	2	4	8
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	2	4	8				
21	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
22	Level	Low	Reactor Bottom valve left open/pass	Health & Fire hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
23	Composition	Other than	No probable cause									

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 1	**Node Description : Grignard reactor (042RT-073)**	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Charging line ROV air failed safe position is air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023					
Node 2		Node Description : EO coupling reactor(042RT-075)											
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R	
Stream-1		Grignard mass (S-2) transferring in EO coupling reactor(042RT-075) by N2 pressure											
1	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard									
		High/More	High pressure of N2 in N2 line	No HSE hazard									
		Reverse	No probable cause										
		Mis-directed flow	No probable cause										
2	Pressure	Low	No probable cause	No HSE hazard									
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurize	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.N2 line maximum pressure is 3 kg/cm2. 4.Double valve is provided in N2 supply line.	3	4	12					
			Human error(Manual ventline/vapour line valve is not open of reactor)		1.Trained manpower will operate the operation. and ensure valve position before start operation.	3	4	12	1.Vent line/vapour line valve should be always locked open condition with tag.	2	4	8	
3	Temperature	Low	Human error(Chilling water supply valve open)	No HSE hazard/Process Delay									

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 2	Node Description : EO coupling reactor(042RT-075)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1. Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
			Human error(TCV bypass line passed/open)		1. CHBS & CWS is provided in the reactor for cooling in case of temperature rise.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging. 2. Interlock to be provided to close steam line TCV at HH temperature of the reactor.	2	4	8
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 2		**Node Description : EO coupling reactor(042RT-075)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.							
			Refer High/More flow									
		High	Tube bundle leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of tube bundle is performed periodically. 3. Incompatible hazard is not there between utility media and reaction mass.	3	3	9				
5	Composition	Other than		No HSE hazard								
6	Other	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9				
		Instrument Air failure		No HSE hazard								
		Power Failure		No HSE hazard								
		DCS Failure		No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**Toluene charging in EO coupling reactor (042RT-075)**										

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 2	Node Description : EO coupling reactor(042RT-075)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
7	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	2	4				
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.							
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	Spill kit to be provided in the nearby area to contain spillage.			
			No level in tank	No HSE hazard								
			Human error (Vent line valve not opened)	Reactor may pressurise	No existing safeguard	3	4	12	1. Vent line valve should be locked open.	2	4	8
			Vent line flame arrestor chocked		1. Flame arrestor PM is performed as per PM schedule. 2. Choking property material is not available.	2	4	8				

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 2	Node Description : EO coupling reactor(042RT-075)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1. Upper limit is freezed in the totaliser to prevent more charging of toluene.	2	2	4				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms.	3	4	12	1. Vent line valve should be locked open condition with tagging. 2. Interlock to be provided to stop charging pump at HH pressure of the reactor. 3. Flash alarm to be provided at HH pressure of the reactor.	2	4	8
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	2	4	8				
9	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided	2	3	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 2		**Node Description : EO coupling reactor(042RT-075)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.							
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay								
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-3		**EO addition in EO coupling reactor (042RT-075) from EO day tank (2KL)**										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of EO day	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up	3	2	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 2		Node Description : EO coupling reactor(042RT-075)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			tank not opened).		before material transferring start. 2.Flow meter is available in transferring line .							
			Human error (manual valve of EO receiving line on EO coupling reactor not opened).									
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3.Fire extinguisher and fire hydrant point is provided in near by area. 4. Flange guard is provided on all flanges. 5.Compatible gasket issued. 6.All electrical installation as per HAC classification.	3	3	9				
			Low level in EO day tank(2KL)	No HSE hazard/Process Delay	Flow meter is available in addition line .	3	2	6				
			Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation. 2.Flow meter PM is performed as per predefined schedule. 3. Choking not possible.	3	2	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 2		Node Description : EO coupling reactor(042RT-075)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water & CHBS provision is available in jacket of the reactor to control temperature. 5. Upper limit of the flow meter & totaliser is freezed as per process requirement. 6. Interlock is provided to closed addition CV at HH temperature of reactor. 3. TMBS is provided with ROV for cooling purpose.	3	4	12	1. Flash alarm to be provided at HH temperature of reactor TI. 2. Interlock to be provided to open TMBS line ROV at HH temperature of reactor.	3	4	12
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened) during addition	Reactor may pressurize	1. Reactor is designed pressure to 6 bar pressure. 2. PT is available on the	3	4	12	1. Vent line valve should be critical locked open with tag. 2. Interlock to be provided	2	4	8

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 2		Node Description : EO coupling reactor(042RT-075)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					reactor with HH alarms.				to close addition line CV at HH pressure of the reactor.			
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition.	3	4	12	1. Flash alarm to be provided at HH pressure of the reactor.	2	4	8
			N2 line manual valve pass/Left open due to human error		1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Double valve is provided in N2 supply line.	3	4	12				
			EO addition rate fast		Refer high flow safeguard	3	4	12				
15	Temperature	Low	Cooling/Chilling water supply valve opened/passed	No HSE hazard								
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.PM of TI is performed before startup operation.	3	4	12				

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 2	Node Description : EO coupling reactor(042RT-075)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	Flash alarm to be provide on HH value of RTD of the reactor.	3	4	12
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			Fast addition rate		1.Flowmeter & totaliser is available in the addition line. 2.Upper limit of flowmeter and totaliser is freeze as per process requirement. 3.Interlock is provided that at HH temperature of reactor EO addition line CV to be closed. 4.Flash alarm is provided on HH temperature of the reactor.	3	4	12				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 2		Node Description : EO coupling reactor(042RT-075)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tube bundle leakage of the reactor		1.Before startup thickness testing is performed. 2.Compatible utility is used.	3	4	12				
16	Level	Low	Reactor Bottom valve left open/pass	health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as per HAC classification.	3	3	9				
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Tube bundle leakage of the reactor	No HSE hazard	1.Before startup thickness testing is performed. 2.Compatible utility is used.	3	3	9				
17	Composition	Other than	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 2		Node Description : EO coupling reactor(042RT-075)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.EO addition line CV air failed safe position is air failed to closed condition.	2	4	8				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.EO addition line CV is closed in case of agitator stop/trip.	2	4	8				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		Node Description : Quenching reactor (041RT-077)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Reaction mass transfer to quenching reactor (041RT-077) by N2 pressure										
1	Quantity/Flow	No/Less	Low pressure of N2 in N2 line	No HSE hazard								
		High/More	High pressure of N2 in N2 line	No HSE hazard								
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurise	1.Vent is provided in reactor & ensure before startup that valve is open condition. 2.Reactor design pressure is 6 bar. 3.N2 line maximum pressure is 3 kg/cm2. 4.Double valve is provided in N2 supply line.	3	4	12	Flash alarm to be provide at HH pressure of reactor.	2	4	8
			Human error(Manual ventline/vapour line valve is not open of reactor)		1.Trained manpower will operate the operation. and ensure valve position before start operation.	3	4	12	1.Vent line/vapour line valve should be always locked open condition with tag.	2	4	8
3	Temperature	Low	Human error(Chilling water supply valve open)	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 3		Node Description : Quenching reactor (041RT-077)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Temperature rise may possible in reactor	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm and interlock is also available.	3	4	12	Flash alarm to be provide on HH value of RTD of the reactor.	3	4	12
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in reactor.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is provided in near by area. 6.All electrical installation as	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		**Node Description : Quenching reactor (041RT-077)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					per HAC classification.							
			Reactor leakage	Incompatible hazard may possible.	PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
5	Composition	Other than		No HSE hazard								
6	Other	Static Electricity		Fire hazard	1. Dual earthing is provided in the reactor & tantalum plug is also provided. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up.	3	3	9				
		Instrument Air failure		No HSE hazard								
		Power Failure		No HSE hazard								
		DCS Failure		No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**20% H2SO4 charging in quenching reactor (041RT-077)**										

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 3		Node Description : Quenching reactor (041RT-077)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
7	Quantity/Flow	No/Less	Human error (Discharge manual valve not opened).	Line may pressurise Health hazard due to spillage	1.PG is available in the discharge line. 2.Trained manpower is deputed. 3. Spill kit is available to contain spillage.	3	3	9				
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket is used. 3.Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms.	3	4	12	1. Vent line valve should be locked open with tagging.	2	4	8
			Low level in 15%H2SO4 tank	No HSE hazard								
			Flow meter malfunction	Process delay	Flowmeter PM is performed before start-up.	3	2	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 3		Node Description : Quenching reactor (041RT-077)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Human error (Wrong input in Totaliser/Flow meter)	1. Exotherm may possible in the reactor and fumes may space through vent line of reactor. 2. Overflow from reactor may lead to spillage hazard	1. Flow meter PM to be done periodically. 2. Interlock is available to close CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Chilling & cooling utility supply provision is available to control temperature. 5. Upper limit of the flow meter & totaliser to be freezed. 6. Interlock to be provided to close CV at HH temperature of reactor. 7.Spill kit is provided at nearby area to contain the spillage.	3	4	12	Flash alarm to be provided at HH temperature of reactor TI.	3	4	12
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 3		Node Description : Quenching reactor (041RT-077)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms.	3	4	12	1. Vent line valve should be locked open. 2. Interlock to be provided to close addition line CV at HH pressure of the reactor.	2	4	8
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	3	4	12				
9	Temperature	Low	CHWS valve opened/pass	No HSE hazard								
		High	Human Error (Manual valve of utility supply & return not opened)	Exotherm may possible in the reactor	1. Trained manpower and SOP is available to line up chilling water before solvent charging. 2. Interlock is available to close addition line CV at HH value of TI in reactor. 3. TI is available in the reactor and utility return & supply line with high and high high alarms. 4. Upper limit of the flow meter & totaliser to be freezed.	3	4	12	Flash alarm to be provide at HH temperature of reactor TI.	3	4	12
			TI malfunction		TI is available in the utility supply & return line with high and high high alarms.	3	4	12				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		Node Description : Quenching reactor (041RT-077)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			More quantity of H2SO4 charge in reactor		Flowmeter & totaliser is available in the addition line.	3	4	12				
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	4	8				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	4	8				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	4	8				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	Air compressor failure	No HSE hazard								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		**Node Description : Quenching reactor (041RT-077)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard								
			DG failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	Exotherm may possible	1.No load tripping is available. 2.Interlock is provided to stop addition line CV at tripping/stop of agitator.	3	4	12				
Stream-3		**Water charging in quenching reactor (041RT-077)**										
13	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow.	2	2	4				
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with alarms.	3	4	12	1. Vent line valve should be locked open with tagging.	2	4	8
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	2	6				
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Upper limit of totaliser to be freeze as per process requirement. 2.Interlock is provided to closed the water	3	2	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 3		Node Description : Quenching reactor (041RT-077)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					transferring line ROV at set value achieved in totaliser.							
			Flow meter malfunction		1.Flow meter PM is performed as per predefined schedule.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
14	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor .	3	4	12	1. Vent line valve should be locked open with tagging.	2	4	8
15	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
16	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be	2	3	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 3		Node Description : Quenching reactor (041RT-077)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					provided on all flanges.							
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
17	Composition	Other than	No probable cause	No HSE hazard								
18	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	-	No HSE hazard								
		Power Failure	-	No HSE hazard								
		DCS Failure	-	No HSE hazard								
		Agitation	-	No HSE hazard								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 4		Node Description : Distillation Column (041CM-040)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from storage tank(40ST-0129) to distillation column(041CM-040) through feeding pump(040TP-265A/B)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provide on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in tank	No HSE hazard/Process Delay								
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		Continuous distillation in distillation column (041CM-040)										

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.	2	3	6
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					column with high and high high alarms.				TCV to be closed and same time bottom collection CV to be closed.			
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2
			Human error (Oil TCV is not open)		1.Oil TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary	2	1	2

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		**Node Description : Distillation Column (041CM-040)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									condenser to be air failed to open.			
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(043TK-208)**									
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.	1	1	1
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 4		Node Description : Distillation Column (041CM-040)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.							
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6	1. Flow meter PM to be done periodically.	2	2	4
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Oil TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.Recommend to provide interlock to stop the XV of transferring line from 1KL to 25KL at HH value of PT of the 25KL tank. 3. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 4		Node Description : Distillation Column (041CM-040)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			line									
15	Temperature	Low	No probable cause					0				0
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023				
Node 4		**Node Description : Distillation Column (041CM-040)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal in tank (040ST-131)**										
19	Quantity/Flow		Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdraw pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	2	3	6
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

P&ID of MEP_Plant-04	Title : HAZOP study of MEP project at 8203 site	Plant Name: Plant-4, Date- 08/12/2023
Node 4	Node Description : Distillation Column (041CM-040)	

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3	1.Production supervisor need to confirm valve position before start operation.	2	1	2
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard/Process Delay								
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3	1. Flow meter PM to be done periodically.	2	1	2
		High/More	Bottom collection CV passed	Overflow may possible	1.LI is available in receiver with high and high high alarm.	3	3	9	1.Interlock to be provided that at HH value of LI of storage tank bottom collection CV to be closed.	2	3	6
			Bypass valve of CV passed/left open									
		Reverse	No probable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.PT is provided in collection tank with high and high high alarm. 3. PVRV is available in the tank.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.At HH value of PT of tank collection line CV to be closed. 3, Flash alarm to be provided in at the HH alarm of PT.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	3	3	9	1.Flame arrestor PM to be performed before start up.	2	3	6
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	Fire hazard	No existing safeguard	3	3	9	Recommend to provide blind or remove Oil line connection in jacket of the receiver.	2	3	6
22	Level	Low	Tank leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI is available in the tank with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 4		Node Description : Distillation Column (041CM-040)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									passing/leakage.			
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from storage tank(40ST-0137) to distillation column(041CM-042) through feeding pump(040TP-277A/B)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provide on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in tank	No HSE hazard/Process Delay								
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		Continuous distillation in distillation column (041CM-042)										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.	2	3	6
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5	Node Description : 041CM-042 (Continuous Toluene Distillation Column)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2

P&ID of MEP_Plant-04				Title : HAZOP study of MEP project at 8203 site					Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with indication in DCS.							
			Human error (Oil TCV is not open)		1.Oil TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		**Node Description : 041CM-042 (Continuous Toluene Distillation Column)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.	2	1	2
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(043TK-215)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5	Node Description : 041CM-042 (Continuous Toluene Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.							
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5	Node Description : 041CM-042 (Continuous Toluene Distillation Column)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6
			Human error(Oil TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.Recommend to provide interlock to stop the XV of transferring line from 1KL to 6KL at HH value of PT of the 6KL tank. 3. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		**Node Description : 041CM-042 (Continuous Toluene Distillation Column)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal in tank (040TK-217)**										
19	Quantity/Flow		Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3	1.Production supervisor need to confirm valve position before start operation.	2	1	2
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3	1. Flow meter PM to be done periodically.	2	1	2
		High/More	Bottom collection CV passed Bypass valve of CV passed/left open	Overflow may possible	1.LI & loadcell is available in receiver with high and high high alarm.	3	3	9	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2.PT is provided in collection tank with high and high high alarm.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2.At HH value of PT of tank collection line CV to be closed. 3, Flash alarm to be provided in at the HH alarm of PT.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	3	3	9	1.Flame arrestor PM to be performed before start up.	2	3	6
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	No HSE hazard								
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI & loadcell is	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 5		Node Description : 041CM-042 (Continuous Toluene Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					available in the tank with low and low low alarms.				2.Equipment thickness testing to be carried out as per define schedule.			
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from receiver(40TK-217) to distillation column(041CM-043) through feeding pump (040TP-280A/B)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provide on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		Continuous distillation in distillation column (041CM-043)										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up.	3	4	12	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum	2	4	8

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms.				pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.			
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.	2	3	6
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.				closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.			
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	2	3	6
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Oil TCV is not open)		1.Oil TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		**Node Description : 041CM-043 (Low Boiler Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.	2	1	2
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(043TK-218)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay	Loadcell is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.	1	1	1
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					vent line.							
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay								
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Oil TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-4		Bottom withdrawal in tank (040TK-219)										
19	Quantity/Flow		Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	2	3	6
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3	1.Production supervisor need to confirm valve position before start operation.	2	1	2

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard/Process Delay								
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3	1. Flow meter PM to be done periodically.	2	1	2
		High/More	Bottom collection CV passed Bypass valve of CV passed/left open	Overflow may possible	1.LI & loadcell is available in receiver with high and high high alarm.	3	3	9	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. Receiver design pressure is 6 bar.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	2	2	4
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	No HSE hazard								
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI & loadcell is available in the tank with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 6		Node Description : 041CM-043 (Low Boiler Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from receiver(40TK-219) to distillation column(041CM-044) through feeding pump (040TP-281A/B)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in receiver	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Flow meter malfunctioning/ Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		**Node Description : 041CM-044 (Flash MEP Distillation Column)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			valve left open)									
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (041CM-044)**										

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7	Node Description : 041CM-044 (Flash MEP Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column.	2	3	6
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	2	3	6
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2
			Human error (Oil TCV is not open)		1.Oil TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Oil TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed. 3.Utility supply line XV of primary and secondary condenser to be air failed to open.	2	1	2
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done	3	1	3				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					for the same periodically.							
		Agitation	Not applicable									
Stream-3		Top collection in receiver(043TK-220)										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			No/low level in distillation column	No HSE hazard/Process Delay	Loadcell is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.	1	1	1
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed. 2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay								
		High/More	Tube leakage in	1.Material	1.Pressure test is	3	3	9	1.Flash alarm to be	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			condenser	incompatible hazard 2.Receiver may overflow	performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.				provide on high high value of Loadcell & level switch activation of receiver.			
			Human error(Oil TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		**Node Description : 041CM-044 (Flash MEP Distillation Column)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal in tank (041TK-222)**										
19	Quantity/Flow		Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9	1.Flash alarm to be provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	2	3	6

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay								
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard/Process Delay								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3	1. Flow meter PM to be done periodically.	2	1	2
		High/More	Bottom collection CV passed Bypass valve of CV passed/left open	Overflow may possible	1.LI & loadcell is available in receiver with high and high high alarm.	3	3	9	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. Receiver design pressure is 6 bar.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	2	2	4
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	No HSE hazard								
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI & loadcell is available in the tank with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023		
Node 7		Node Description : 041CM-044 (Flash MEP Distillation Column)									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site							Plant Name: Plant-4, Date- 08/12/2023			
Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Pure MEP distillation in 041CM-045										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8
		High Vacuum	No probable cause	No HSE hazard								
3	Temperature	Low	No probable cause	No HSE hazard								

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop oil TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop Oil line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High	No probable cause									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of Oil line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.	2	4	8
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 8		**Node Description : 041CM-045 (Batch MEP Distillation Column)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.TCV of Oil line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.	2	4	8
Stream-2		**Collection of pure MEP in receiver 042TK-224A**									
7	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			No/low level in distillation column	No HSE hazard/Process Delay								

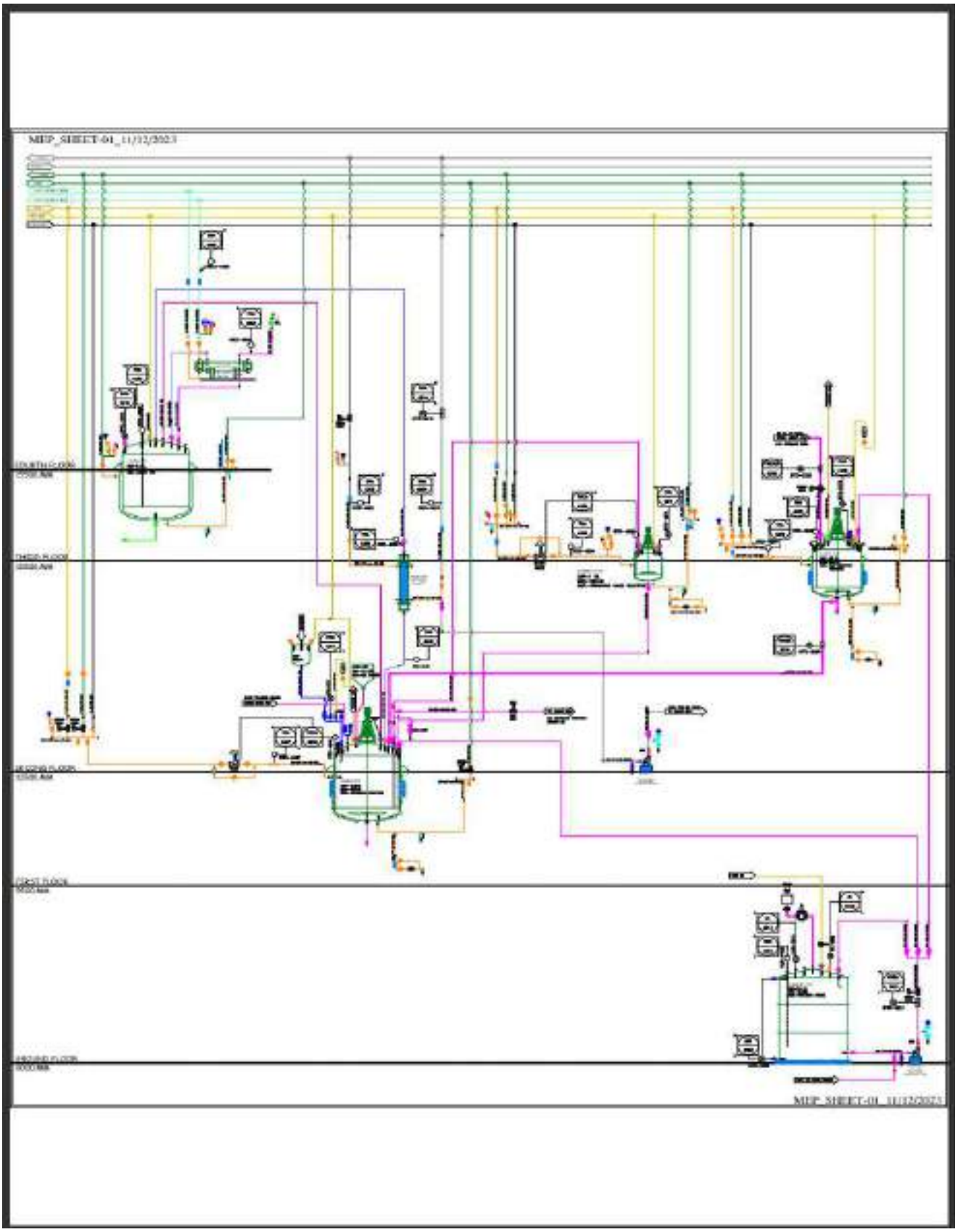
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Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil PCV to be closed. 2.At HH temperature of final vent line Oil PCV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay								

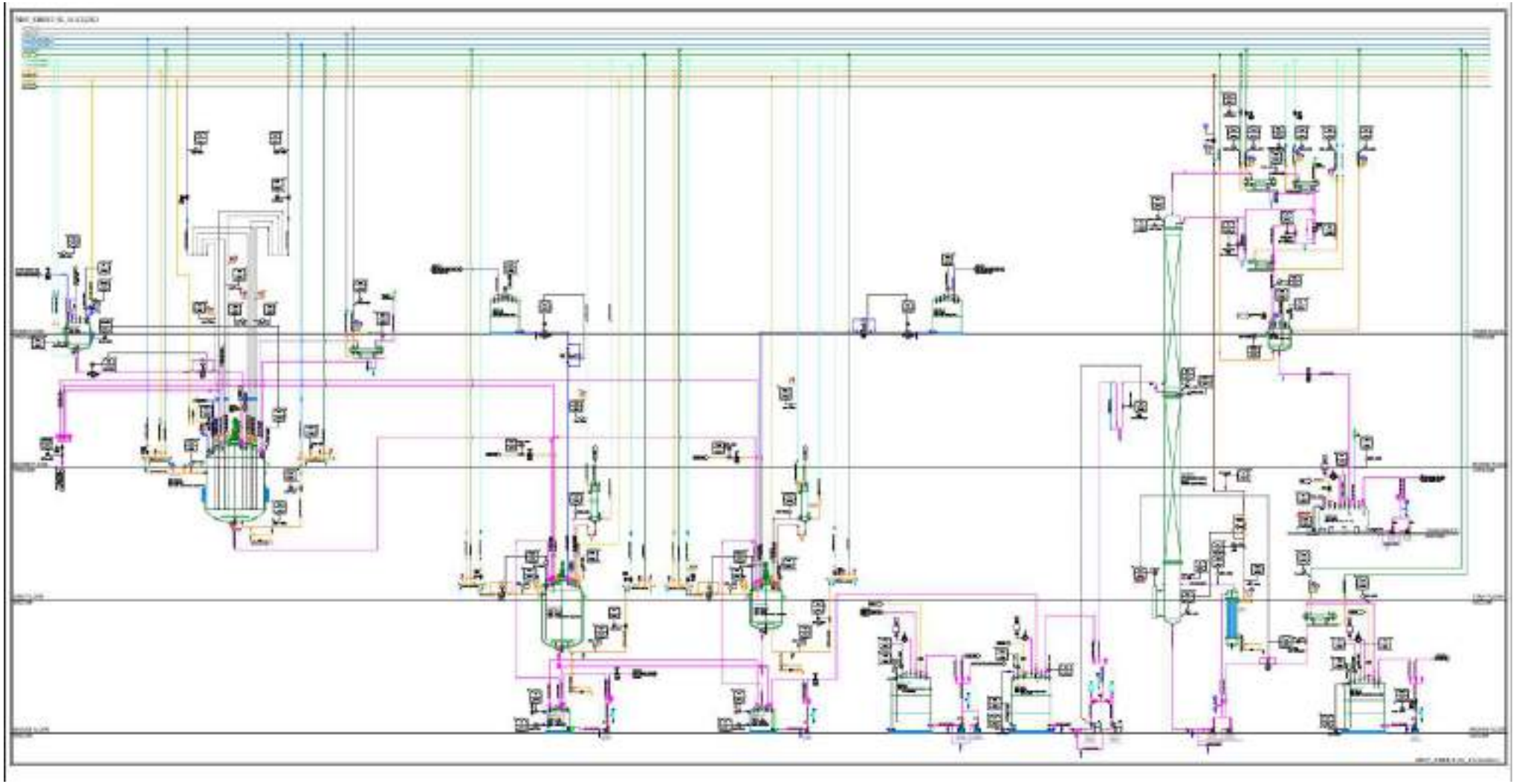
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Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of LI of receiver.	2	3	6
			Human error(Oil PCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provide that at HH temperature of top of the column Oil PCV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of	2	2	4

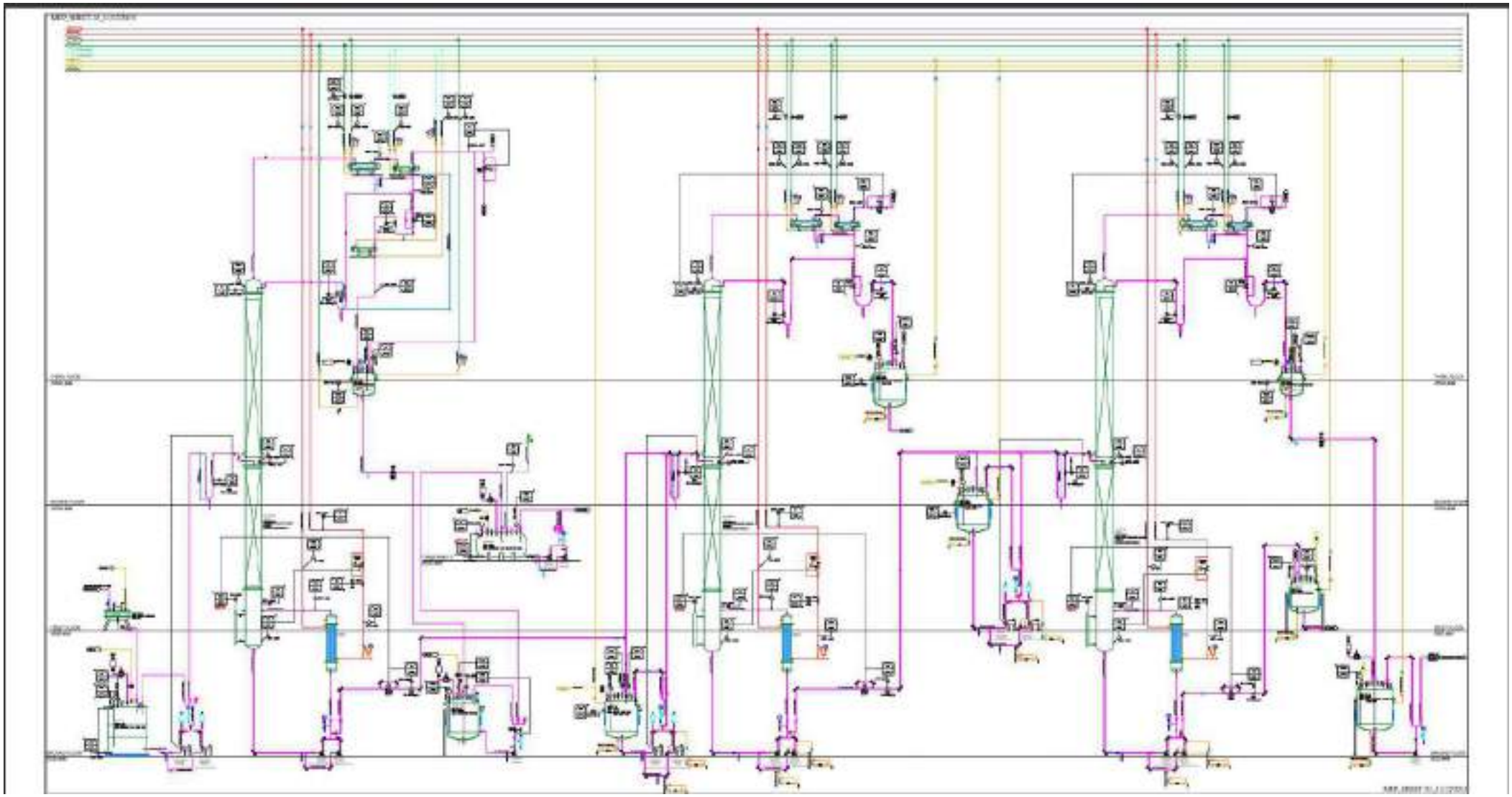
P&ID of MEP_Plant-04		Title : HAZOP study of MEP project at 8203 site						Plant Name: Plant-4, Date- 08/12/2023			
Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									receiver.			
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									
11	Composition	Other than	No probable cause									

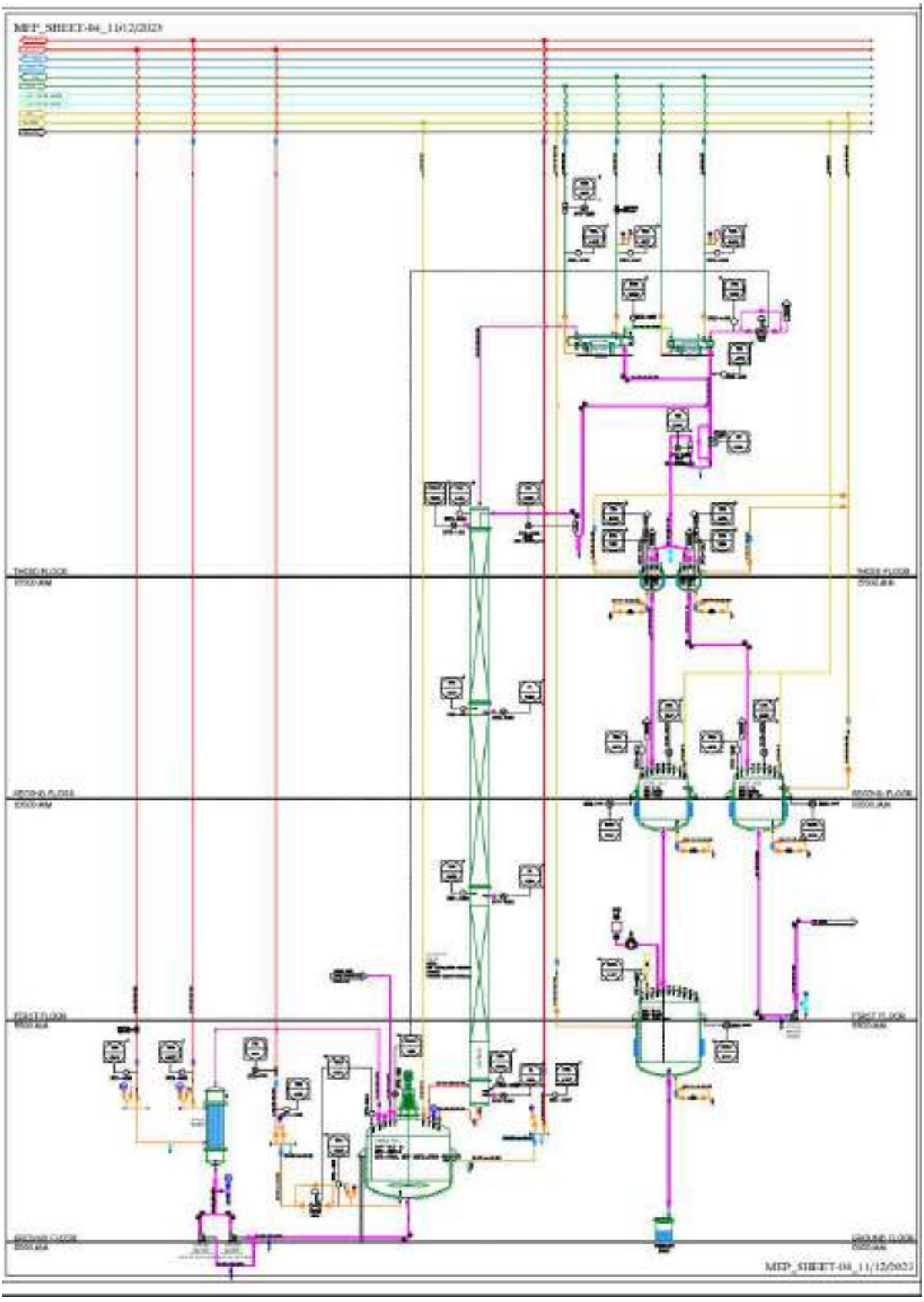
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Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				

APPENDIX-2: P&ID DIAGRAMS









----- END OF THE REPORT -----

MEP HAZOP Report Recommendations Status					
	Sr.No.	Recommendations			
Node 1		Grignard reactor (042RT-073)	Status	Action Taken	Page Ref. No.
Stream-1		Mg turnings charging into grignard reactor(042RT-073)			
	1	1. Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	2	2. Area barrication to be done to restrict man movement during charging.	Completed	Implemented in Field	-
Stream-2		Heating in grignard reactor (042RT-073)			
	3	1. Flash alarm to be provide on HH value of PT of the reactor.	Completed	Implemented in DCS	2
	4	1.Vent line/vapour line valve should be always locked open condition with tag.	Completed	Implemented in Field	3
	5	1.Flash alarm is provided on HH value of RTD of the reactor.	Completed	Implemented in DCS	2
	6	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
Stream-3		PCP charging in the reactor (042RT-073)			
	7	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
	8	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	9	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
	10	1.Spill kit to be provided in nearby area to contain spillage.	Completed	Implemented in Field	1
	11	2.Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	12	3.Compatible gasket to be used to prevent gasket leakage.	Completed	Implemented in Field	-
Stream-4		THF charging in the reactor (042RT-073)			
	13	Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	14	1. Vent line valve should be locked open.	Completed	Implemented in Field	3
	15	1. Vent line valve should be locked open condition with tagging.	Completed	Implemented in Field	3
	16	2. Interlock to be provided to stop charging pump at HH pressure of the reactor.	Completed	Implemented in DCS	6
	17	3. Flash alarm to be provided at HH pressure of the reactor.	Completed	Implemented in DCS	2
Node 2		Node Description : EO coupling reactor(042RT-075)			
Stream-1		Grignard mass (S-2) transferring in EO coupling reactor(042RT-075) by N2 pressure			
	18	1.Vent line/vapour line valve should be always locked open condition with tag.	Completed	Implemented in Field	3
	19	1. Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	2
	20	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
	21	2. Interlock to be provided to close steam line TCV at HH temperature of the reactor.	Completed	Implemented in DCS	7
Stream-2	22	Toluene charging in EO coupling reactor (042RT-075)			
	23	Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	24	1. Vent line valve should be locked open.	Completed	Implemented in Field	3
	25	1. Vent line valve should be locked open condition with tagging.	Completed	Implemented in Field	3
	26	2. Interlock to be provided to stop charging pump at HH pressure of the reactor.	Completed	Implemented in DCS	7
	27	3. Flash alarm to be provided at HH pressure of the reactor.	Completed	Implemented in DCS	2
Stream-3	28	EO addition in EO coupling reactor (042RT-075) from EO day tank (2KL)			
	29	1. Flash alarm to be provided at HH temperature of reactor TI.	Completed	Implemented in DCS	2
	30	2. Interlock to be provided to open TMBS line ROV at HH temperature of reactor	Completed	Implemented in DCS	8

	31	1. Vent line valve should be critical locked open with tag.	Completed	Implemented in Field	3
	32	2. Interlock to be provided to close addition line CV at HH pressure of the reactor.	Completed	Implemented in DCS	8
	33	1. Flash alarm to be provided at HH pressure of the reactor.	Completed	Implemented in DCS	2
	34	Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	2
	35	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
Node 3		**Node Description : Quenching reactor (041RT-077)**			
Stream-1		**Reaction mass transfer to quenching reactor (041RT-077) by N2 pressure**			
	36	Flash alarm to be provide at HH pressure of reactor.	Completed	Implemented in DCS	2
	37	1.Vent line/vapour line valve should be always locked open condition with tag.	Completed	Implemented in Field	3
	38	Flash alarm to be provide on HH value of RTD of the reactor.	Completed	Implemented in DCS	2
	39	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
Stream-2	40	**20% H2SO4 charging in quenching reactor (041RT-077)**			
	41	1. Vent line valve should be locked open with tagging.	Completed	Implemented in Field	3
	42	Flash alarm to be provided at HH temperature of reactor TI.	Completed	Implemented in DCS	9
	43	1. Vent line valve should be locked open.	Completed	Implemented in Field	3
	44	2. Interlock to be provided to close addition line CV at HH pressure of the reactor.	Completed	Implemented in DCS	10
	45	Flash alarm to be provide at HH temperature of reactor TI.	Completed	Implemented in DCS	9
Stream-3	46	**Water charging in quenching reactor (041RT-077)**			
	47	1. Vent line valve should be locked open with tagging.	Completed	Implemented in Field	3
Node 4		**Node Description : Distillation Column (041CM-040)**			
Stream-1		**Continuous feeding from storage tank(40ST-0129) to distillation column(041CM-040) through feeding pump(040TP-265A/B)**			
	48	1.Pump running indication to be provide on DCS.	Completed	Implemented in DCS	11
	49	2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	Completed	Implemented in Field	12
	50	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	51	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	52	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	53	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	54	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in DCS	12
	55	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	14
	56	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	15
	57	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in DCS	12
	58	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	14
	59	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	15
	60	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	12
	61	2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	12
	62	3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	12

	63	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	15
	64	1 At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed	Completed	Implemented in DCS	12
	65	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	66	3.Flash alarm to be provide on HH pressure of top and bottom of the column.	Completed	Implemented in DCS	15
	67	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	16
	68	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed	Completed	Implemented in DCS	12
	69	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed	Completed	Implemented in DCS	12
	70	1.TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	17
	71	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	15
	72	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	12
	73	1.TCV bypass valve should be locked closed condition with tagging	Completed	Implemented in Field	4
	74	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump, Oil TCV to be closed.	Completed	Implemented in DCS	12
	75	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	12
	76	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	17
Stream-2		**Continuous distillation in distillation column (041CM-040)**			
	77	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	12
	78	2. Interlock to be provided to close oil. TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	12
	79	3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	12
	80	4 Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	15
	81	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed.	Completed	Implemented in DCS	12
	82	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	83	3.Flash alarm to be provide on HH pressure of top and bottom of the column.	Completed	Implemented in DCS	15
	84	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	16
	85	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	17
	86	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	12
	87	1.TCV stroke testing to be carried out as per define schedule	Completed	Implemented in Field	17
	88	2 Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	15

	89	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	12
	90	1 TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
	91	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed.	Completed	Implemented in DCS	12
	92	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	12
	93	1.CV stroke testing to be carried out as per defined PM scheoule.	Completed	Implemented in Field	17
	94	1.Oil TCV air fail safe position to be air fa lec to close.	Completed	Implemented in Field	-
	95	2.Distillator column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	-
	96	3.Utility supply line XV of primary and secondary condenser to be air failed to open.	Completed	Implemented in Field	-
Stream-3		Top collection in receiver(043TK-208)			
	97	1 Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	98	2. Line design pressure need to be confirmed before startup	Completed	Implemented in Field	5
	99	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in DCS	13
	100	2.Spill kit to be provide to contain spillage	Completed	Implemented in Field	1
	101	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.	Completed	Implemented in DCS	12
	102	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	12
	103	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop,and also bottom collection CV to be closed.	Completed	Implemented in DCS	12
	104	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	18
	105	1.Flash alarm to be provide on high high value of Loadcel & level switch activation of receiver.	Completed	Implemented in DCS	15
	106	1.Flash alarm to be provide on HH temperature of top of the column.	Completed	Implemented in DCS	15
	107	2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.	Completed	Implemented in DCS	12
	108	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	109	2.Recommend to provide interlock to stop the XV of transferring line from 1KL to 25KL at HH value of PT of the 25KL tank.	Completed	Implemented in DCS	12
	110	3. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	15
	111	1 Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	19
	112	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	113	2 Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	20
	114	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
Stream-4		Bottom withdrawal in tank (040ST-131)			
	115	1.Flash alarm to be provide on HH value of LI of sump of Distillation column.	Completed	Implemented in DCS	21

	116	2.Interlock to be provide that if bottom withdraw pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	Completed	Implemented in DCS	12
	117	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	118	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	119	1.Production supervisor need to confirm valve position before start operation.	Completed	Implemented in Field	-
	120	1.Recommended to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	121	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	122	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	22
	123	1.Interlock to be provided that at HH value of LI of storage tank bottom collection CV to be closed.	Completed	Implemented in DCS	12
	124	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	125	2.At HH value of PT of tank collection line CV to be closed.	Completed	Implemented in DCS	12
	126	3, Flash alarm to be provided in at the HH alarm of PT.	Completed	Implemented in DCS	21
	127	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	23
	128	Recommend to provide blind or remove Oil line connection in jacket of the receiver.	Completed	Implemented in Field	24
	129	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	130	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	25
	131	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
Node 5		**Node Description : 041CM-042 (Continuous Toluene Distillation Column)**			
Stream-1		**Continuous feeding from storage tank(40ST-0137) to distillation column(041CM-042) through feeding pump(040TP-277A/B)**			
	132	1.Pump running indication to be provide on DCS.	Completed	Implemented in Field	48
	133	2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	Completed	Implemented in DCS	26
	134	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	135	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	136	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	137	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	138		Completed	Implemented in Field	-
	139	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in DCS	26
	140	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	27
	141	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	15
	142	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in Field	26
	143	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	27
	144	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	15
Stream-2		**Continuous distillation in distillation column (041CM-042)**			
	145	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	26
	146	2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	26

	147	3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	26
	148	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	15
	149	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed	Completed	Implemented in DCS	26
	150	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	151	3.Flash alarm to be provide on HH pressure of top and bottom of the column.	Completed	Implemented in DCS	15
	152	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	28
	153	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed	Completed	Implemented in DCS	26
	154	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	Completed	Implemented in DCS	26
	155	1.TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	17
	156	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	15
	157	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	26
	158	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
	159	1.Interlock to be provide that in case of bottom with draw pump trip/stop than feeding pump,Oil TCV to be closed.	Completed	Implemented in DCS	26
	160	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	26
	161	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	17
	162	1.Oil TCV air fail safe position to be air failed to close	Completed	Implemented in Field	-
	163	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	-
	164	3 Utility supply line XV of primary and secondary condenser to be air failed to open.	Completed	Implemented in Field	-
Stream-3		**Top collection in receiver(043TK-215)**			
	165	1. Spill kit to be provided in the nearby area to contain spillage	Completed	Implemented in Field	1
	166	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	167	1.Recommended to provide double valve/blind provision to prevent valve passing/ eakage.	Completed	Implemented in DCS	13
	168	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	169	1 Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	26
	170	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	26
	171	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver	Completed	Implemented in DCS	15
	172	1.Flash alarm to be provice on HH temperature of top of the column.	Completed	Implemented in DCS	15
	173	2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom with draw pump to be stop and top & bottom collection CV to be closed.	Completed	Implemented in DCS	26

	174	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	175	2.Recommend to provide interlock to stop the XV of transferring line from 1KL to 6KL at HH value of PT of the 6KL tank.	Completed	Implemented in DCS	26
	176	3. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	15
	177	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	29
	178	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	179	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	30
	180	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
Stream-4		**Bottom withdrawal in tank (040TK-217)**			
	181	1.Flash alarm to be provide on HH value of LI of sump of distillation column.	Completed	Implemented in DCS	15
	182	2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	Completed	Implemented in DCS	26
	183	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	184	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	185	1.Production supervisor need to confirm valve position before start operation.	Completed	Implemented in Field	-
	186	1.Recommended to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	187	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	188	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	31
	189	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.	Completed	Implemented in DCS	26
	190	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	191	2.At HH value of PT of tank collection line CV to be closed.	Completed	Implemented in DCS	26
	192	3, Flash alarm to be provided in at the HH alarm of PT.	Completed	Implemented in DCS	15
	193	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	32
	194	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	195	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	33
	196	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
Node 6		**Node Description : 041CM-043 (Low Boiler Distillation Column)**			
Stream-1	197	**Continuous feeding from storage tank(405T-0129) to distillation column(041CM-040) through feeding pump(040TP-265A/B)**			
	198	1.Pump running indication to be provide on DCS.	Completed	Implemented in Field	34
	199	2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	Completed	Implemented in DCS	35
	200	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	201	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	202	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in DCS	13
	203	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	204	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in DCS	35

	205	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	36
	206	3 Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	37
	207	1.Feeding line flow meter upper limit to be freeze	Completed	Implemented in Field	35
	208	2.PM of feeding pump to be carried out as per define frequency	Completed	Implemented in Field	36
	209	3 Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	37
Stream-2		**Continuous distillation in distillation column (041CM-043)**			
	210	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	35
	211	2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	35
	212	3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	35
	213	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	37
	214	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed.	Completed	Implemented in DCS	35
	215	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	2
	216	3.Flash alarm to be provide on HH pressure of top and bottom of the column.	Completed	Implemented in DCS	37
	217	1.Interlock to be provice that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	Completed	Implemented in DCS	35
	218	2 At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	35
	219	1 TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	17
	220	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	37
	221	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	35
	222	1.TCV bypass valve shoulc be locked closed condition with tagging.	Completed	Implemented in Field	4
	223	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed.	Completed	Implemented in DCS	35
	224	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	35
	225	1 CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	17
	226	1.Oil TCV air fail safe position to be air failed to close.	Completed	Implemented in Field	-
	227	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed	Completed	Implemented in Field	
	228	3.Utility supply line XV of primary and secondary condenser to be air failed to open.	Completed	Implemented in Field	-
Stream-3		**Top collection in receiver(043TK-218)**			
	229	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	230	2. Line design pressure need to be confirmed before startup	Completed	Implemented in Field	5
	231	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage	Completed	Implemented in Field	13
	232	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	233	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.	Completed	Implemented in DCS	35

	234	1 Inter ock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	35
	235	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	35
	236	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	Comp eted	Implemented in DCS	37
	237	1.Flash alarm to be provide on HH temperature of top of the column.	Comp eted	Implemented in DCS	37
	238	2.Interlock to be provide that at HH temperature of top of the column Oil TCV to be closed and same time feeding pump and bottom withdraw pump to be stop and top & bottom collection CV to be closed.	Completed	Implemented in DCS	35
	239	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	240	2. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	37
	241	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	40
	242	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	243	2 Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	41
	244	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
Stream-4		**Bottom withdrawal in tank (040TK-219)**			
	245	1.Flash alarm to be provide on HH value of LI of sump of distillation column.	Completed	Implemented in DCS	37
	246	2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	Completed	Implemented in DCS	35
	247	1. Spill kit to be provided in the nearby area to contain spillage	Completed	Implemented in Field	1
	248	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	249	1.Production supervisor need to confirm valve position before start operation	Completed	Implemented in Field	-
	250	1.Recommended to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	251	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	252	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	42
	253	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.	Completed	Implemented in DCS	35
	254	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	255	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	256	2.Equipment thickness testing to be carried out as per define schedule	Completed	Implemented in Field	41
	257	1 Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
	258	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	259	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	260	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	261	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	262	1.Feeding line flow-meter upper limit to be freeze.	Completed	Implemented in Field	35
	263	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	36
	264	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in Field	37

	265	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in Field	35
	266	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	36
	267	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	37
Node 7		**Node Description : 041CM-044 (Flash MEP Distillation Column)**			
Stream-1		**Continuous feeding from receiver(40TK-219) to distillation column(041CM-044) through feeding pump (040TP-281A/B)**			
	268	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	269	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	270	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	271	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	272	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in Field	38
	273	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	43
	274	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	37
Stream-2		**Continuous distillation in distillation column (041CM-044)**			
	275	1. Recommend to provide interlock to stop the CV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	38
	276	2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	38
	277	3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	38
	278	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	37
	279	1.At HH pressure of top and bottom of the column reboiler Oil TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed.	Completed	Implemented in DCS	38
	280	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	281	3.Flash alarm to be provide on HH pressure of top and bottom of the column.	Completed	Implemented in DCS	37
	282	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	38
	283	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	38
	284	1.TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	17
	285	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	37
	286	3.Interlock to be provide that at HH temperature of top & bottom of the column Oil TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	38
	287	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
	288	1.Interlock to be provide that in case of bottom withdraw pump trip/stop than feeding pump,Oil TCV to be closed.	Completed	Implemented in DCS	38
	289	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	38
	290	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	17
	291	1.Oil TCV air fail safe position to be air failed to close.	Completed	Implemented in Field	-
	292	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	-
	293	3.Utility supply line XV of primary and secondary condenser to be air failed to open.	Completed	Implemented in Field	-

Stream-3		Top collection in receiver(043TK-220)			
	294	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	295	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	296	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	13
	297	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	298	1.Recommend to provide interlock that at LL value of LI of column, Oil TCV and bottom withdraw CV to be closed and also bottom withdraw pump to be stop.	Completed	Implemented in DCS	38
	299	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	38
	300	2.At HH temperature of final vent line Oil TCV to be closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	Completed	Implemented in DCS	38
	301	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	Completed	Implemented in DCS	37
	302	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	303	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	44
	304	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
	305	1.Flash alarm to be provide on HH value of LI of sump of distillation column.	Completed	Implemented in DCS	37
	306	2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time feeding pump to be stop and Oil TCV, bottom collection line CV to be closed.	Completed	Implemented in DCS	38
	307	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	308	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	309	1.Recommended to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in DCS	13
	310	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	311	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	45
	312		Completed	Implemented in Field	45
	313		Completed	Implemented in Field	45
	314	1.Interlock to be provided that at HH value of LI of receiver bottom collection CV to be closed.	Completed	Implemented in DCS	38
	315	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	316	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	317	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	44
	318	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	13
Node 8		Node Description : 041CM-045 (Batch MEP Distillation Column)			
Stream-1	319	Pure MEP distillation in 041CM-045			
	320	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	39
	321	2. Interlock to be provided to close oil TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	39
	322	3. Interlock to be provided to stop Oil line TCV at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	39
	323	4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	Completed	Implemented in DCS	37

	324	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops.	Completed	Implemented in DCS	39
	325	2. Interlock to be provided to stop oil TCV at vacuum drop & vacuum pump trip/stops.	Completed	Implemented in DCS	39
	326	3. Interlock to be provided to stop Oil line TCV at HH temperature of the reactor.	Completed	Implemented in DCS	39
	327	4. Flash alarm to be provided at HH temperature of the reactor.	Completed	Implemented in DCS	37
	328	1.PM of TCV is to be performed as per predefined schedule.	Completed	Implemented in Field	17
	329	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	4
	330	1. Double manual valve to be provide to prevent valve passing.	Completed	Implemented in Field	13
	331	2.Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	332	1.TCV of Oil line air failed safe position to be air fail to close.	Completed	Implemented in Field	-
	333	2.PCV of vacuum pot air fail safe position to be air fail to close.	Completed	Implemented in Field	-
	334	3.ROV of vacuum line air fail safe position to be air fail to open.	Completed	Implemented in Field	-
Stream-2		**Collection of pure MEP in receiver 042TK-224A**			
	335	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	336	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	5
	337	1.Interlock to be provide that at LL value of flow meter in cooling water supply line in PHE ,Oil PCV to be closed.	Completed	Implemented in DCS	39
	338	2.At HH temperature of final vent line Oil PCV to be closed.	Completed	Implemented in DCS	39
	339	1.Flash alarm to be provide on high high value of LI of receiver.	Completed	Implemented in DCS	37
	340	1.Flash alarm to be provide on HH temperature of top of the column.	Completed	Implemented in DCS	37
	341	2.Interlock to be provide that at HH temperature of top of the column Oil PCV to be closed.	Completed	Implemented in DCS	39
	342	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	343	2. Flash alarm to be provided at HH pressure of receiver.	Completed	Implemented in DCS	37
	344	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	46
	345	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	346	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	47

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	Stream-1	53	
	Stream-3	97	
	Stream-3	100	
	Stream-3	112	
	Stream-4	117	
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Node 5	Stream-1	134	
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Node 8	Stream-1	331	
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	Stream-2	345	

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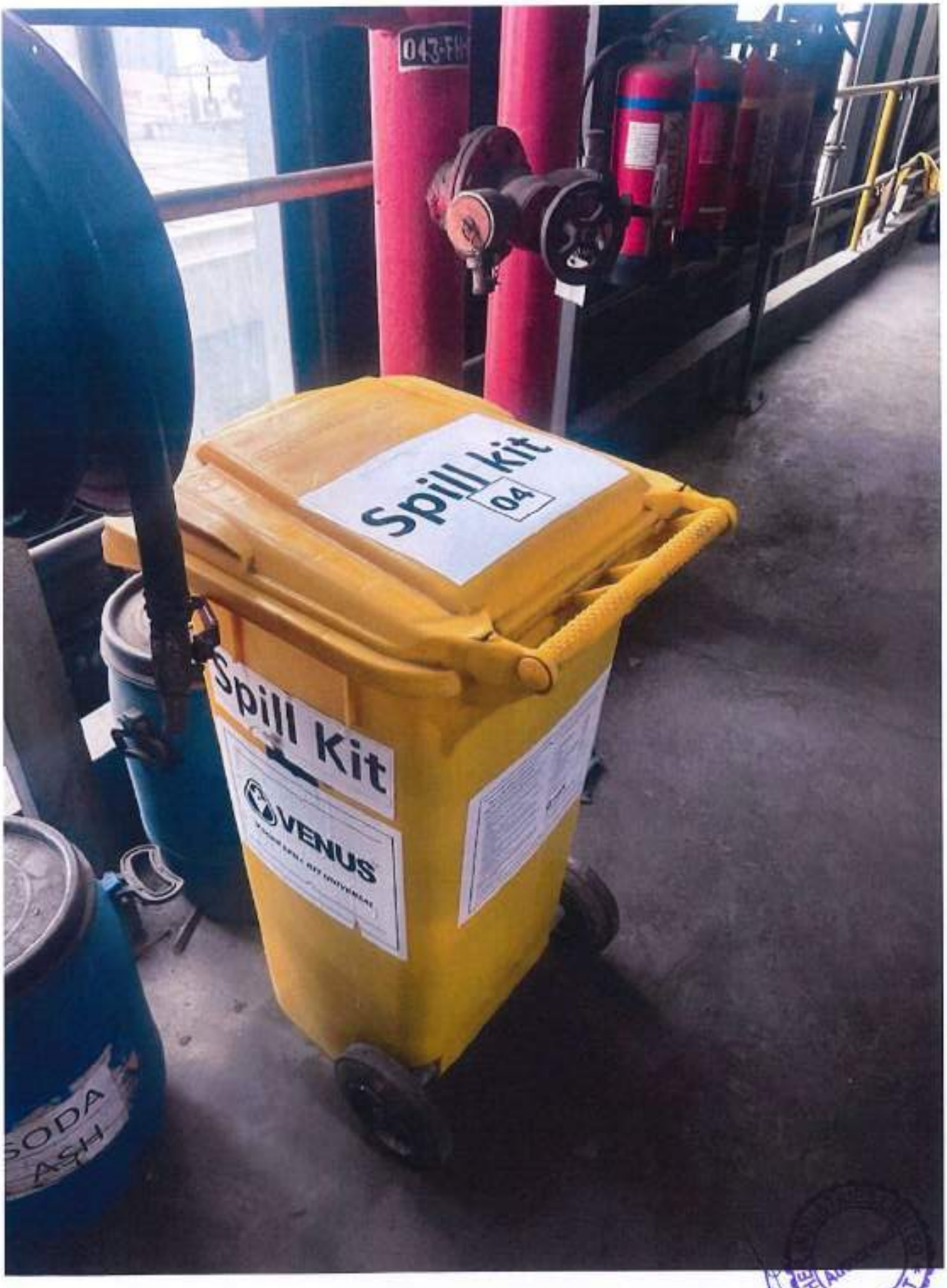



Spill kit
02

2503

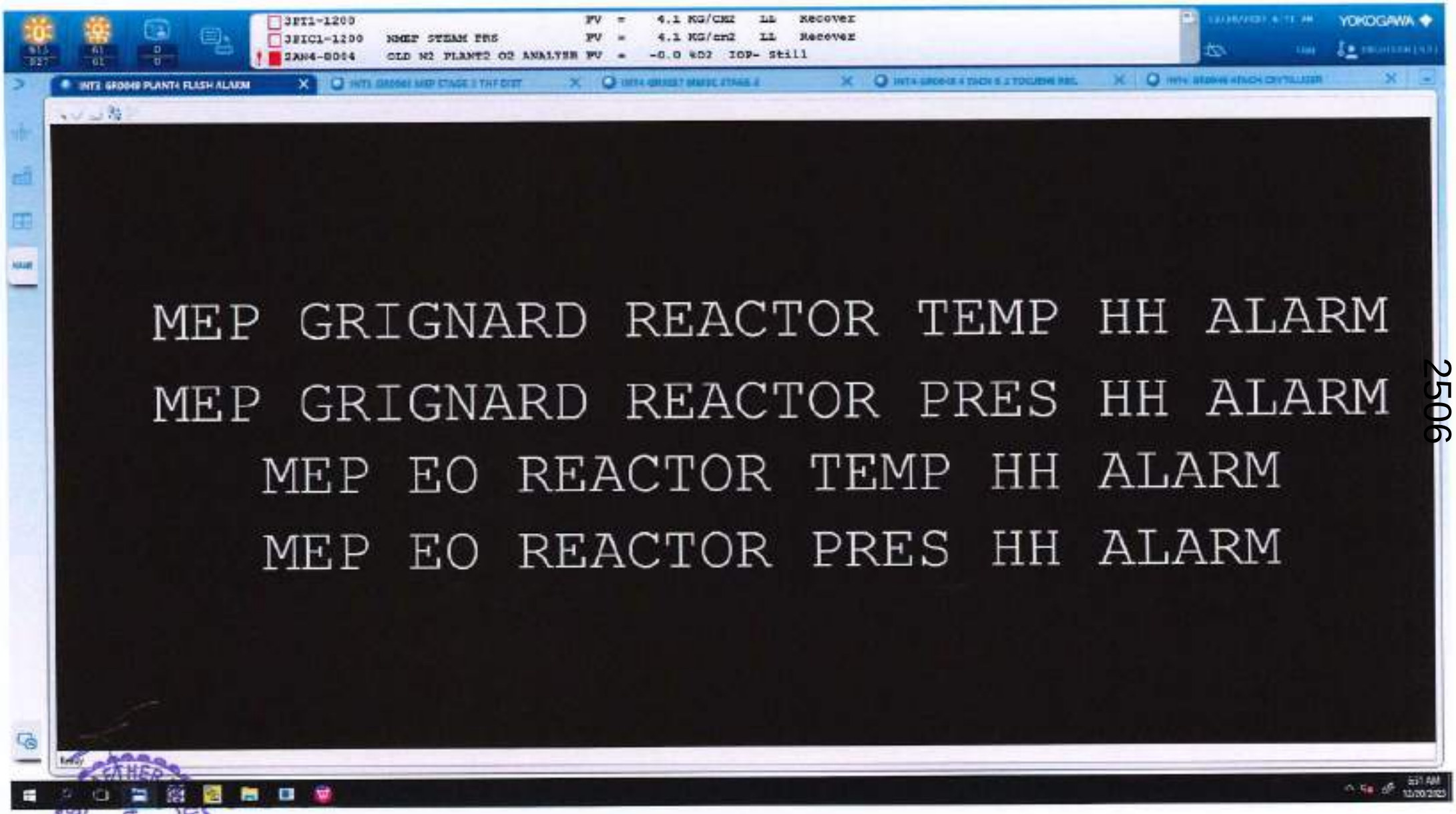


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043-FH
Spill kit
04
Spill Kit
VENUS
SODA
ASH

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Node 3	Stream-1	36	2
	Stream-1	38	2

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MEP GRIGNARD REACTOR TEMP HH ALARM
MEP GRIGNARD REACTOR PRES HH ALARM
MEP EO REACTOR TEMP HH ALARM
MEP EO REACTOR PRES HH ALARM

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	Stream-2	25	
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Node 3	Stream-1	37	
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	Stream-2	43	
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Node 4	Stream-1	65	
	Stream-2	82	
	Stream-3	108	
	Stream-4	124	
Node 5	Stream-2	150	
	Stream-3	174	
	Stream-4	190	
Node 6	Stream-2	215	
	Stream-3	239	
	Stream-4	254	
Node 7	Stream-2	280	
	Stream-3	315	
Node 8	Stream-2	342	

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	Stream-3	35	
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Node 5	Stream-2	158	
Node 6	Stream-2	222	
Node 7	Stream-2	287	
Node 8	Stream-1	329	

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Node 5	Stream-1	135	
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Node 6	Stream-1	201	
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	Stream-4	248	
	Stream-4	259	
Node 7	Stream-1	269	
	Stream-3	295	
	Stream-3	308	
Node 8	Stream-2	336	



JINDAL PIPES LIMITED

WORKS(MILL) TEST CERTIFICATE

(ERW PIPES)

T.C No. : JPL/E-V/QC/2866/2022
T.C Date : 11/11/2023
Process/Product : GI PIPE

Customer : MUGATLAL B. & SONS
O.C. No. : 1137
W.O. No. : VS/TU/2673/23-24

1.WE CERTIFY THAT THE MATERIAL DESCRIBED BELOW FULLY CONFIRM TO IS:1239 (PT1) 2004.CHEMICAL COMPOSITION.MECHANICAL/PHYSICAL PROPERTIES AND DIMENSIONS OF THE PRODUCT HAVE BEEN TESTED IN ACCORDANCE WITH THE SCHEME OF TESTING AND INSPECTION CONTAINED IN BIS CERTIFICATION MARKS LICENCE NO.CM/L:7487695

Description					Quantity		HydroStatic Testing	
S No.	Size	Specification	Heat No.	Coil No	Pcs	Length (in mtrs)	End Finish	Pressure (KG/CM2)	Holding Time (Sec)
1	B.K 88.90 X 4.80 X 6000MM HEAVY P/E	IS:1239(PT-1)	7357855	7855-S-231-2006	60	360.00	P/E	51	3
2	G.I 33.40 X 4.00 X 6000MM HEAVY P/E	IS:1239(PT-1)	7357867	7867-S-231-1925	179	1075.79	P/E	51	3
3	G.I 114.30 x 5.40 x 6000 MM HEAVY P/E	IS:1239(PT-1)	B020995	0995-J-231-2288	41	247.18	P/E	51	3

IS:1239(PT-1)

	Mechanical Properties							Chemical Composition (%)						
S No.	Heat No.	Coil No.	YST (Mpa)	UTS (Mpa)	EL (%)	Flattening	Bend Test	LA/PA	C	Mn	S	P	Si	AL	C.E.
	Required Values	Min. Max.	NA					LA	0.200	1.300	0.040	0.040			
1	7357855	7855-S-231-2006	NA	405.92	26.66	OK	NA	LA	0.070	0.260	0.018	0.023	0.099	0.033	
2	7357867	7867-S-231-1925	NA	394.22	24.26	NA	OK	LA	0.070	0.250	0.017	0.020	0.085	0.029	
3	B020995	0995-J-231-2288	NA	406.24	25.28	OK	NA	LA	0.062	0.323	0.015	0.012	0.018	0.055	

1. Dimensions : OUTSIDE DIAMETER,THICKNESS,WEIGHT,LENGTH,CONFIRM TO ABOVE SPECIFICATION
2. RUST Preventive : ALL PIPES/TUBES ARE COATED WITH BLACK RUST PREVENTIVE, FROM OUT SIDE SURFACE ONLY.
3. Coating Galvanising : ALL PIPES/TUBES ARE GALVANISHED INSIDE AND OUTSIDE SURFACE AS PER IS4736 SPEC.PW ZINC USED WITH ZINC CONTENT OF 98.5% ABOVE
4. Threading : AS PER IS554

Normal Informations: Applicable for Varnish Sino 1,2 . GI Sino 1,3 . GI SWS 1,3,4 .

MARKING/STENCELLING :

JINDAL STAR

IS:1239(PT-1)
HEAVY
CM/L 7487695

Remark : The above pipes has been manufactured at M/s. Vibhor Steel Tubes Pvt. Limited, under the supervision of JPL
S&S : Screwed & Socketed SWS: Screwed without Socketed EL(%): Upto 25 mm NB is 12 EL(%): Above 25 mm NB is 20

SEAL

For JINDAL PIPES LIMITED

(Authorised Signatory)

YST:Yield Strength, UTS:Ultimate Tensile Strength,EL: Elongation,PE: Plain End,BE: Bevel End, LA:Ladle Analysis, PA:Product Analysis,NA: Not Applicable W.&R.O.:GUT NO :59/2,PIPENAGAR,N.H.17,B.K.G.ROAD,VILLAGE-SUKELI,DIST-RAIGAD,MAHARASHTRA-402126Phone :02194238880

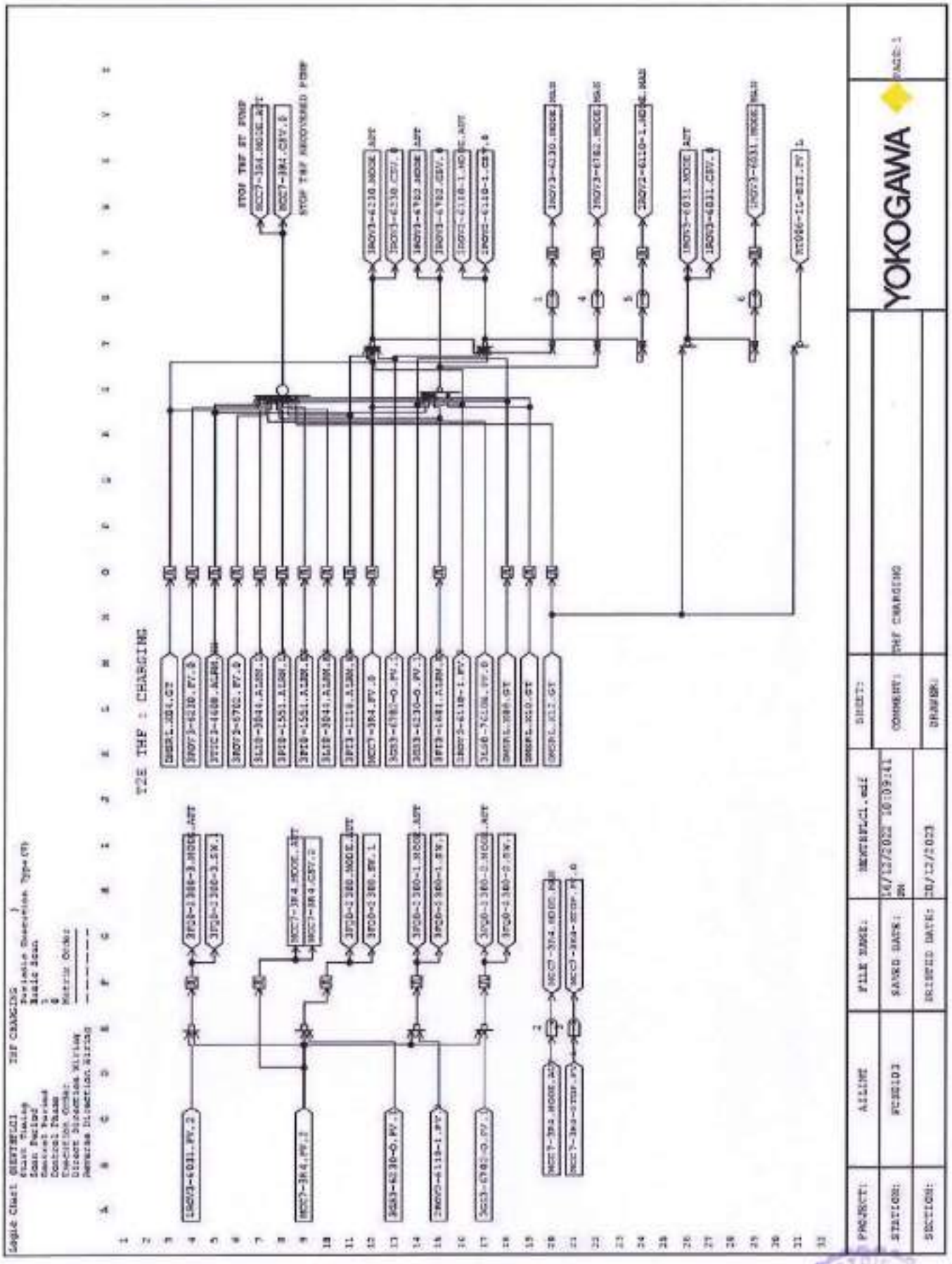
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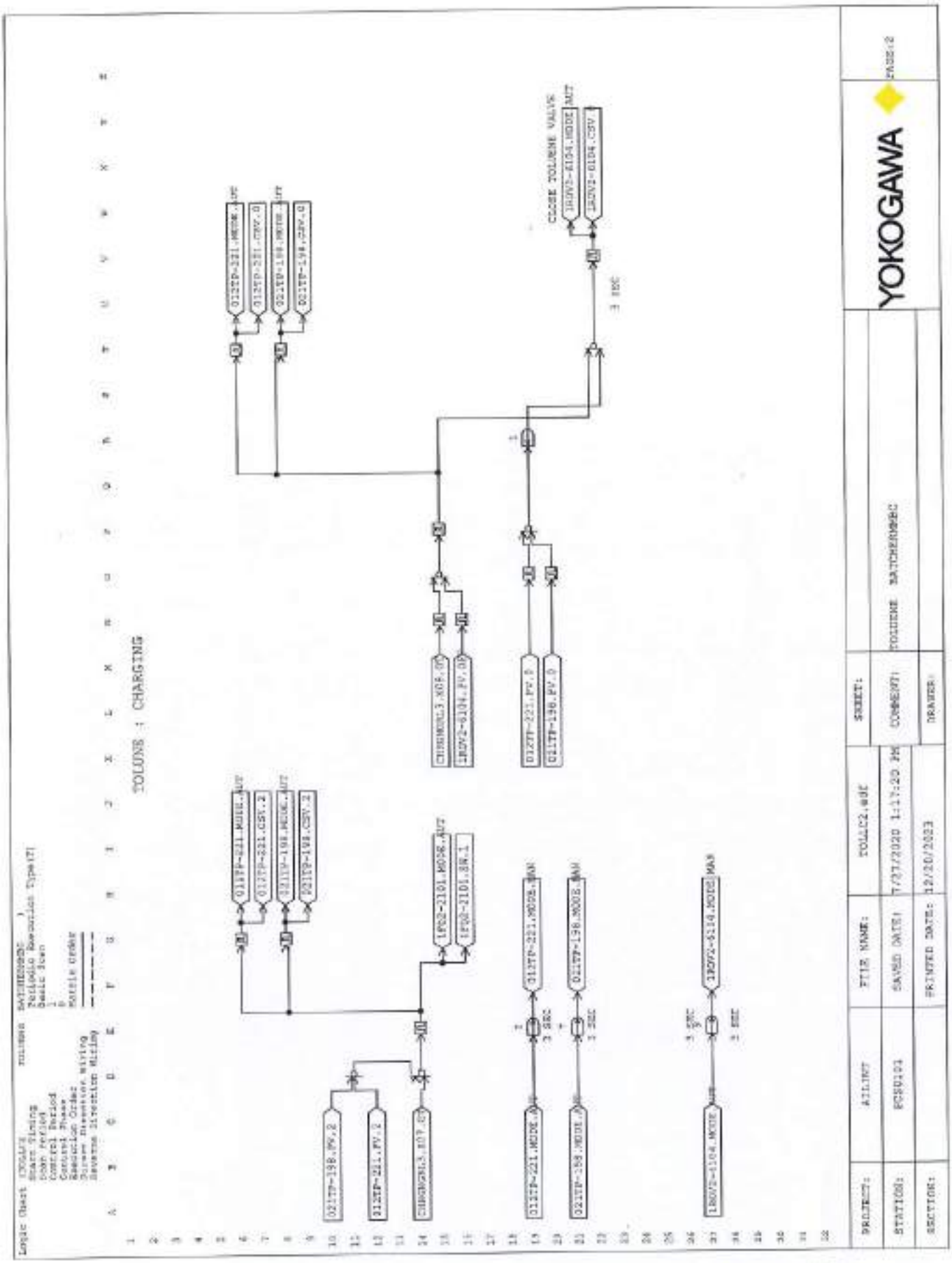



T2E THP : CHARGING
STOP THP RECOVERED PUMP
YOKOGAWA

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Node 2	Stream-1	21	7
	Stream-2	26	

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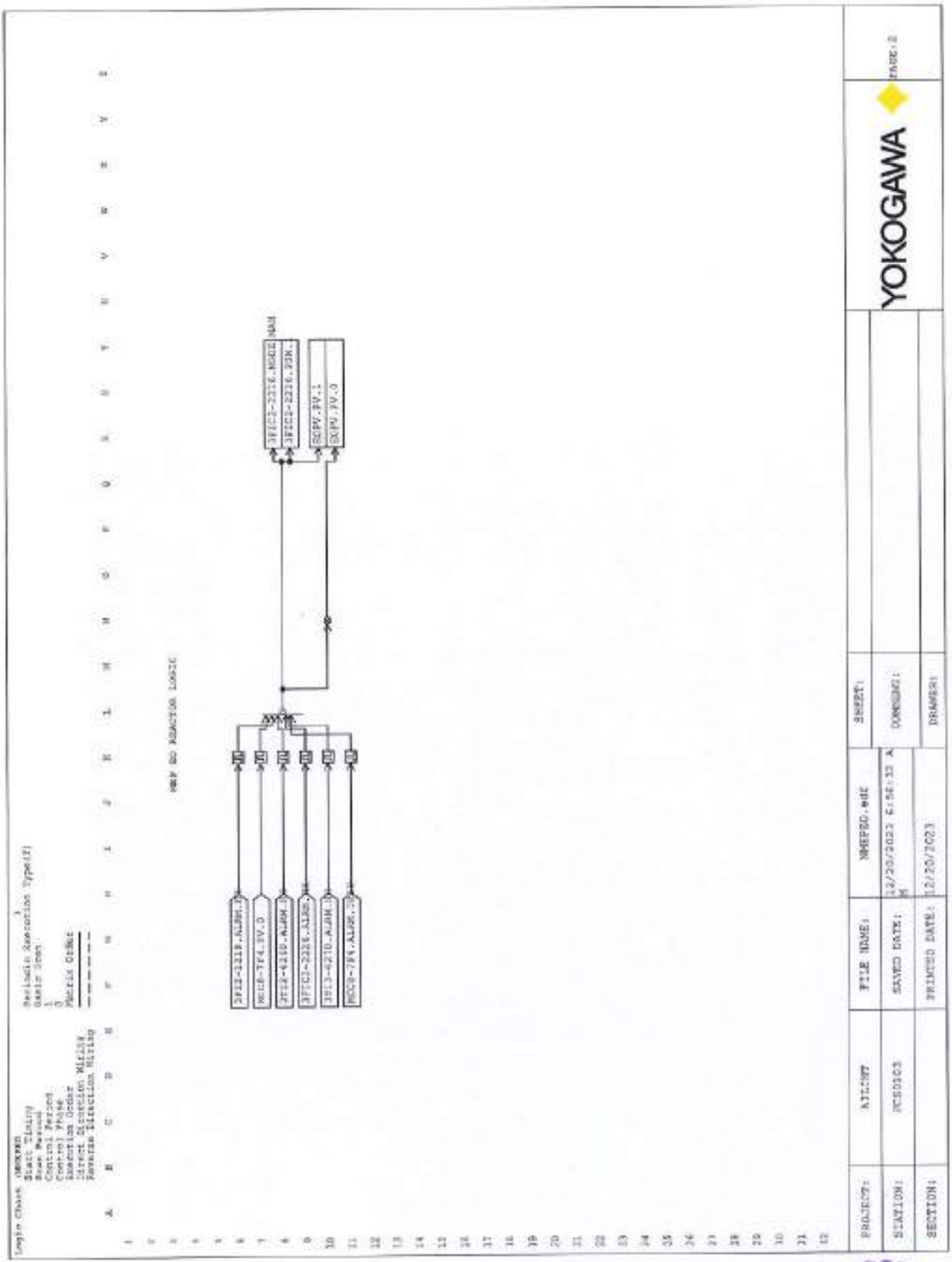


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	Stream-3	32	

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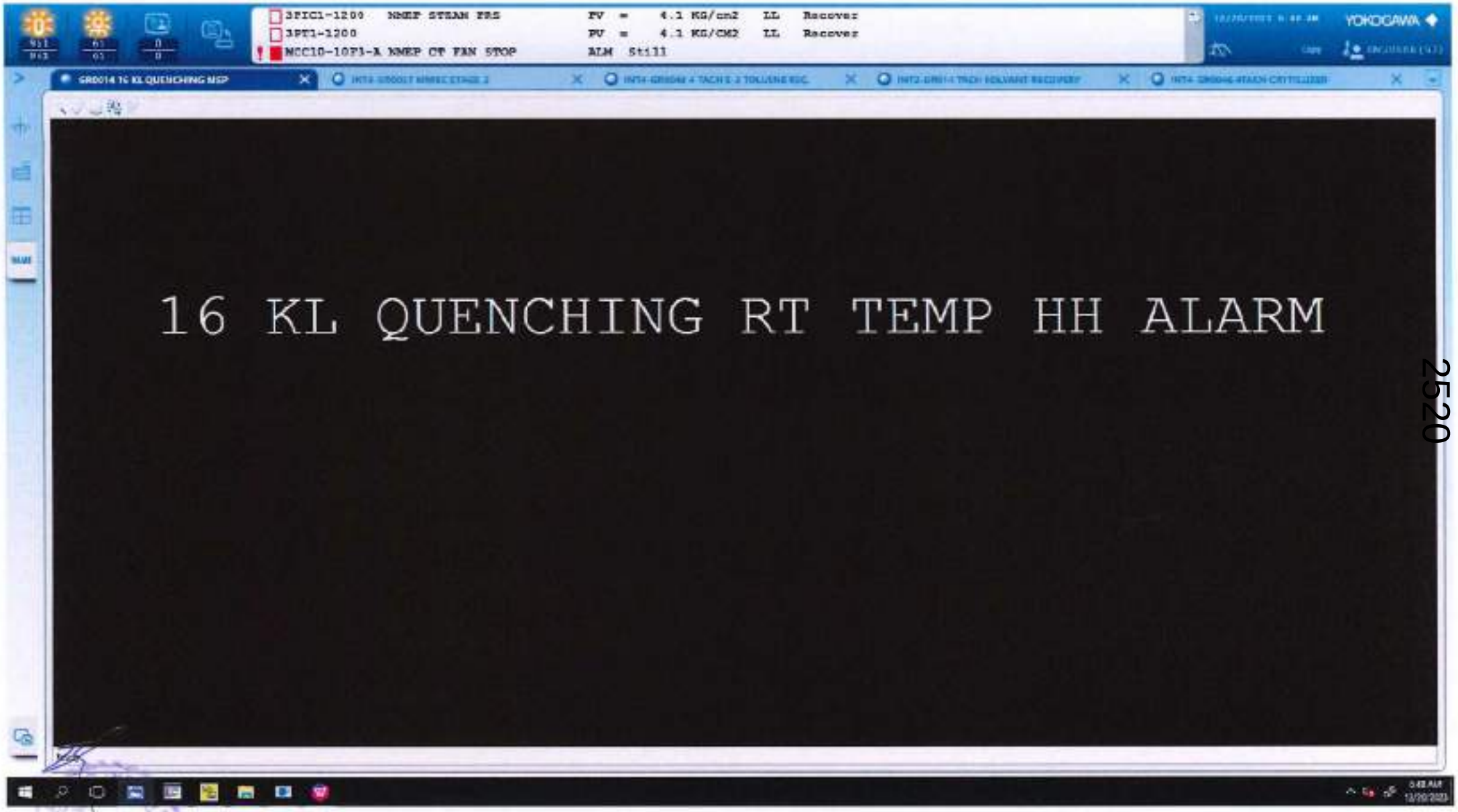


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	Stream-2	45	

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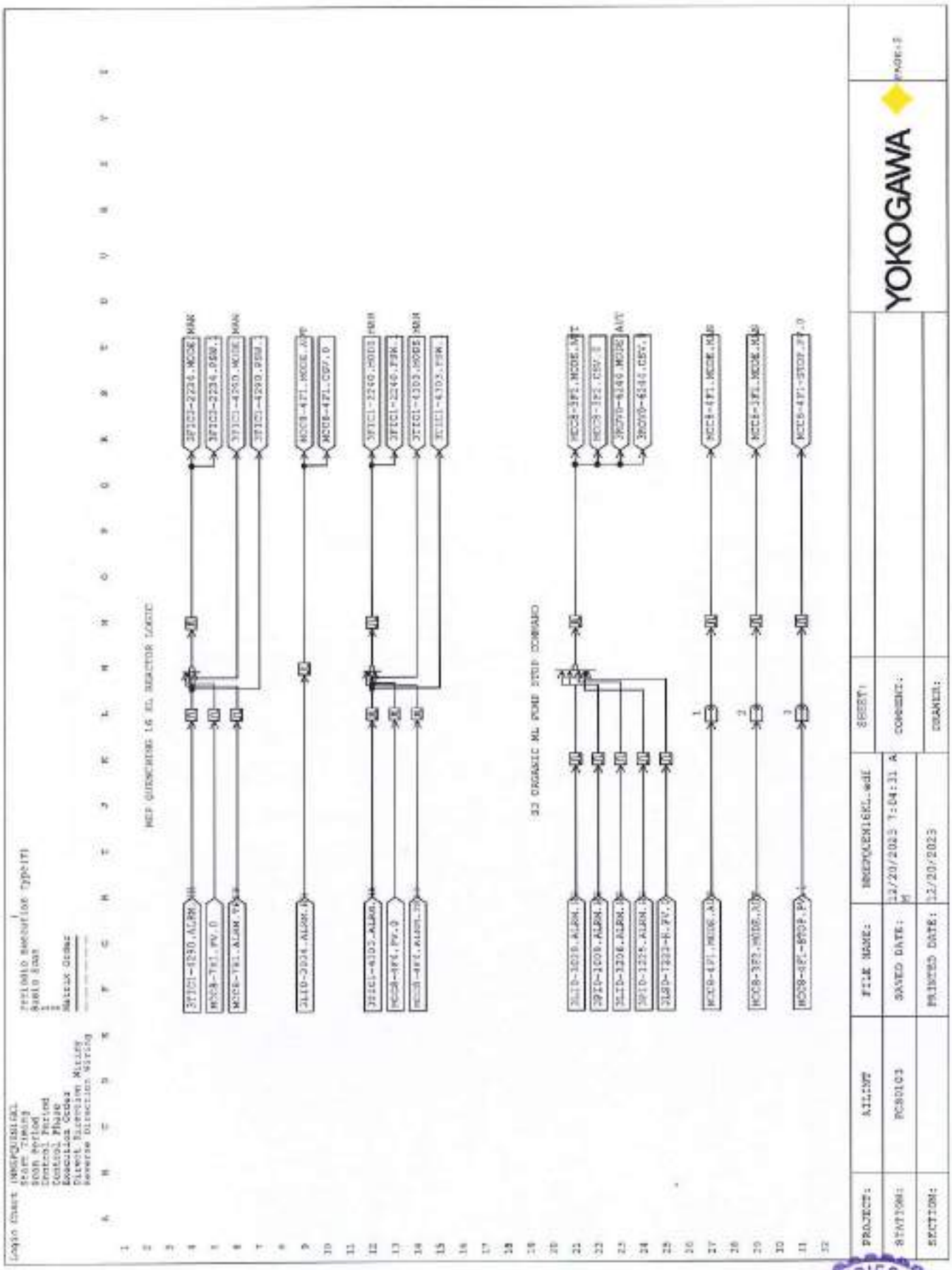

3FIC1-1200 NMEP STEAM FRS FV = 4.1 KG/cm2 LL Recover
3PT1-1200 PV = 4.1 KG/CM2 LL Recover
MCC10-107I-A NMEP CT FAN STOP ALM Still
YOKOGAWA
GR0014 TC KL QUENCHING MSP
16 KL QUENCHING RT TEMP HH ALARM

2520

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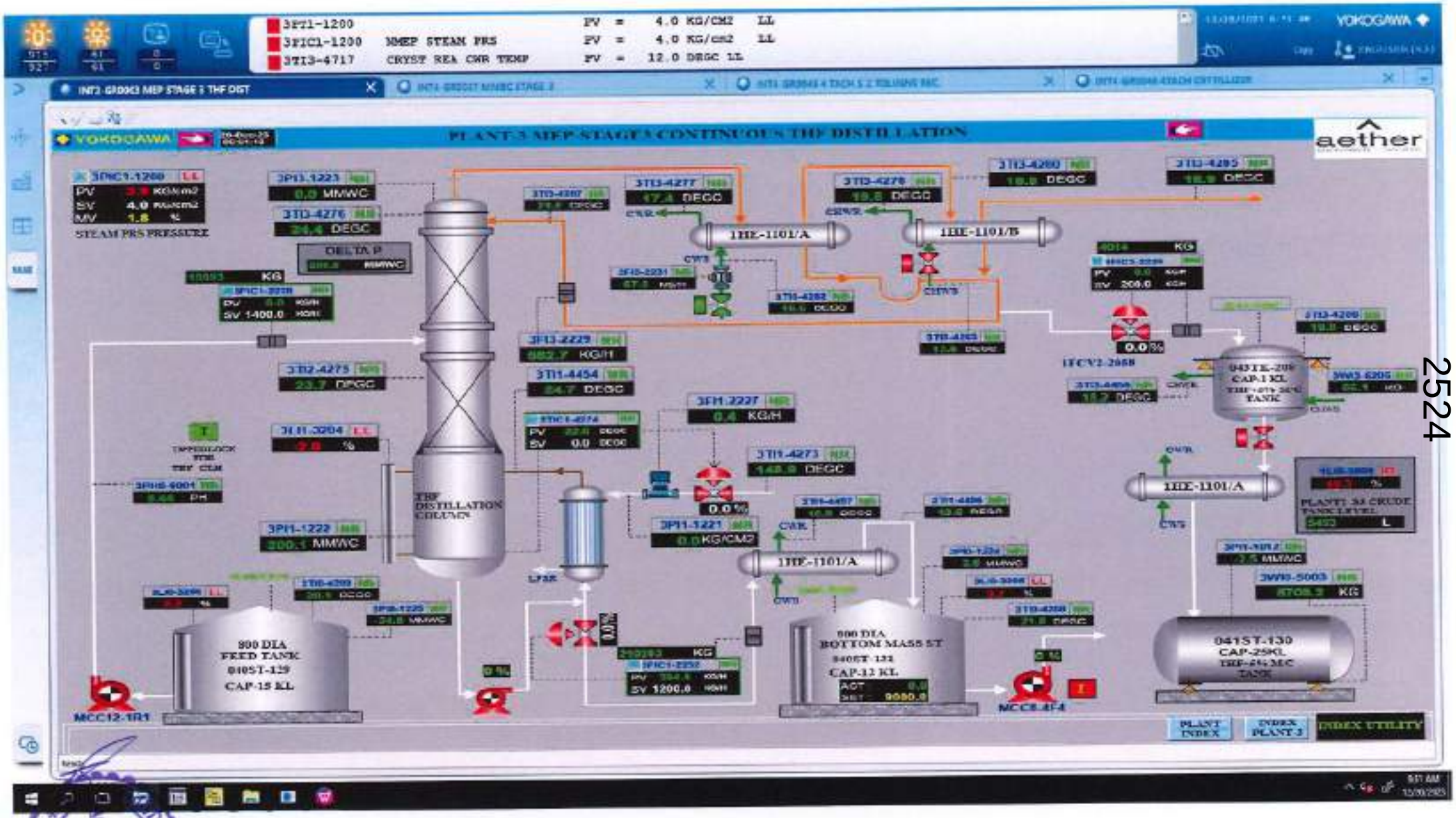


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Node 4	Stream-1	48	11

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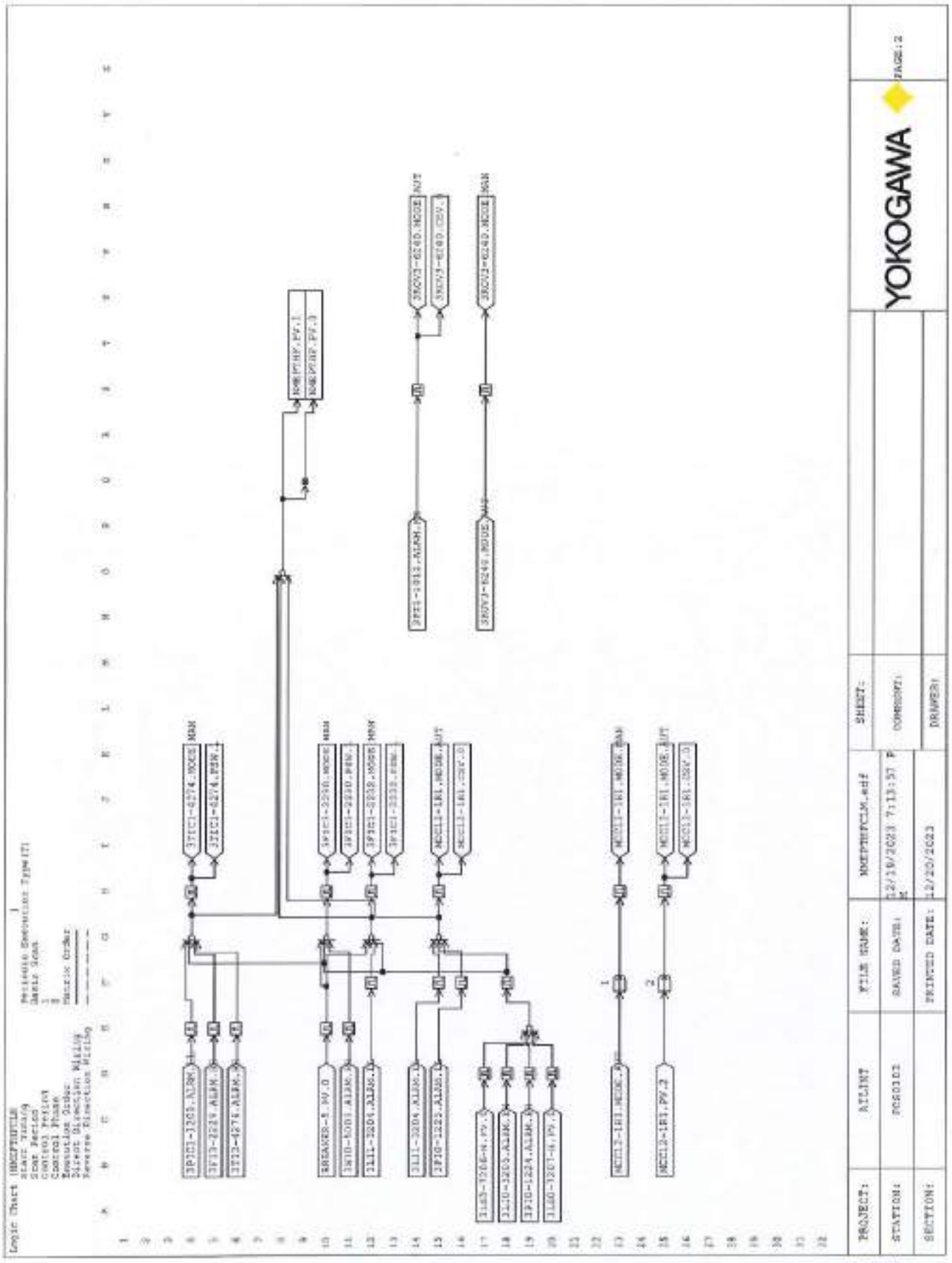

3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 MMEP STEAM PRS PV = 4.0 KG/cm2 LL
3TI3-4717 CRYST REA CWR TEMP PV = 12.0 DEGC LL
YOKOGAWA
PLANT 3 MEP STAGE I CONTINUOUS THF DISTILLATION
aether
STEAM PRS PRESSURE
DELTA P
1HE-1101/A
1HE-1101/B
THF DISTILLATION COLUMN
800 DIA FEED TANK 040ST-129 CAP-15 KL
800 DIA BOTTOM MASS ST 040ST-131 CAP-12 KL
041ST-130 CAP-25KL
MCC12-1R1
MCC8-4F4
PLANT INDEX
INDEX PLANT-3
INDEX UTILITY

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	Stream-1	69	
	Stream-1	72	
	Stream-1	74	
	Stream-1	75	
	Stream-2	77	
	Stream-2	78	
	Stream-2	79	
	Stream-2	81	
	Stream-2	85	
	Stream-2	86	
	Stream-2	89	
	Stream-2	91	
	Stream-2	92	
	Stream-3	101	
	Stream-3	102	
	Stream-3	103	
	Stream-3	107	
	Stream-3	109	
	Stream-4	116	
	Stream-4	123	
	Stream-4	125	

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Node	Stream	Sr.No.	Page Ref. No.
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	Stream-3	114	
	Stream-4	120	
	Stream-4	131	
Node 5	Stream-1	136	
	Stream-3	167	
	Stream-3	180	
	Stream-4	186	
	Stream-4	196	
Node 6	Stream-1	202	
	Stream-3	231	
	Stream-3	244	
	Stream-4	250	
	Stream-4	257	
	Stream-4	260	
Node 7	Stream-1	270	
	Stream-3	296	
	Stream-3	304	
	Stream-3	309	
	Stream-3	318	
Node 8	Stream-1	330	




042RT-0
CAP - 12.5

Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-1	55	14
	Stream-1	58	

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : [illegible] Equipment ID No : [illegible] Block : [illegible]	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	ok	AJAY
2	Check visually foundation of the pump	ok	AJAY
3	Check frame bolting properly tight	ok	AJAY
4	Check the coupling condition	ok	AJAY
5	Check for any abnormal noise and vibrations.	ok	AJAY
6	Check oil level in the bearing housing	oil level mark up	AJAY
7	Check spider condition	Checked ok	AJAY
8	Check the coupling guard properly fitting	Checked ok	AJAY
9	Check all nuts and bolts of pump for tightness	Checked ok	AJAY
10	Check any leakages found from mechanical seal or gland	ok	AJAY

Checked by :

14/11/2023

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 15/12/2023 Equipment ID No : P-1102 A/B Block : UNIT-IV	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	ok	JAIMIN
2	Check visually foundation of the pump	ok	JAIMIN
3	Check frame bolting properly tight	ok	JAIMIN
4	Check the coupling condition	OK	JAIMIN
5	Check for any abnormal noise and vibrations.	OK	JAIMIN
6	Check oil level in the bearing housing	OK	JAIMIN
7	Check spider condition	Checked ok	JAIMIN
8	Check the coupling guard properly fitting	Checked ok	JAIMIN
9	Check all nuts and bolts of pump for tightness	OK	JAIMIN
10	Check any leakages found from mechanical seal or gland	OK	JAIMIN

Checked by :

15/12/2023

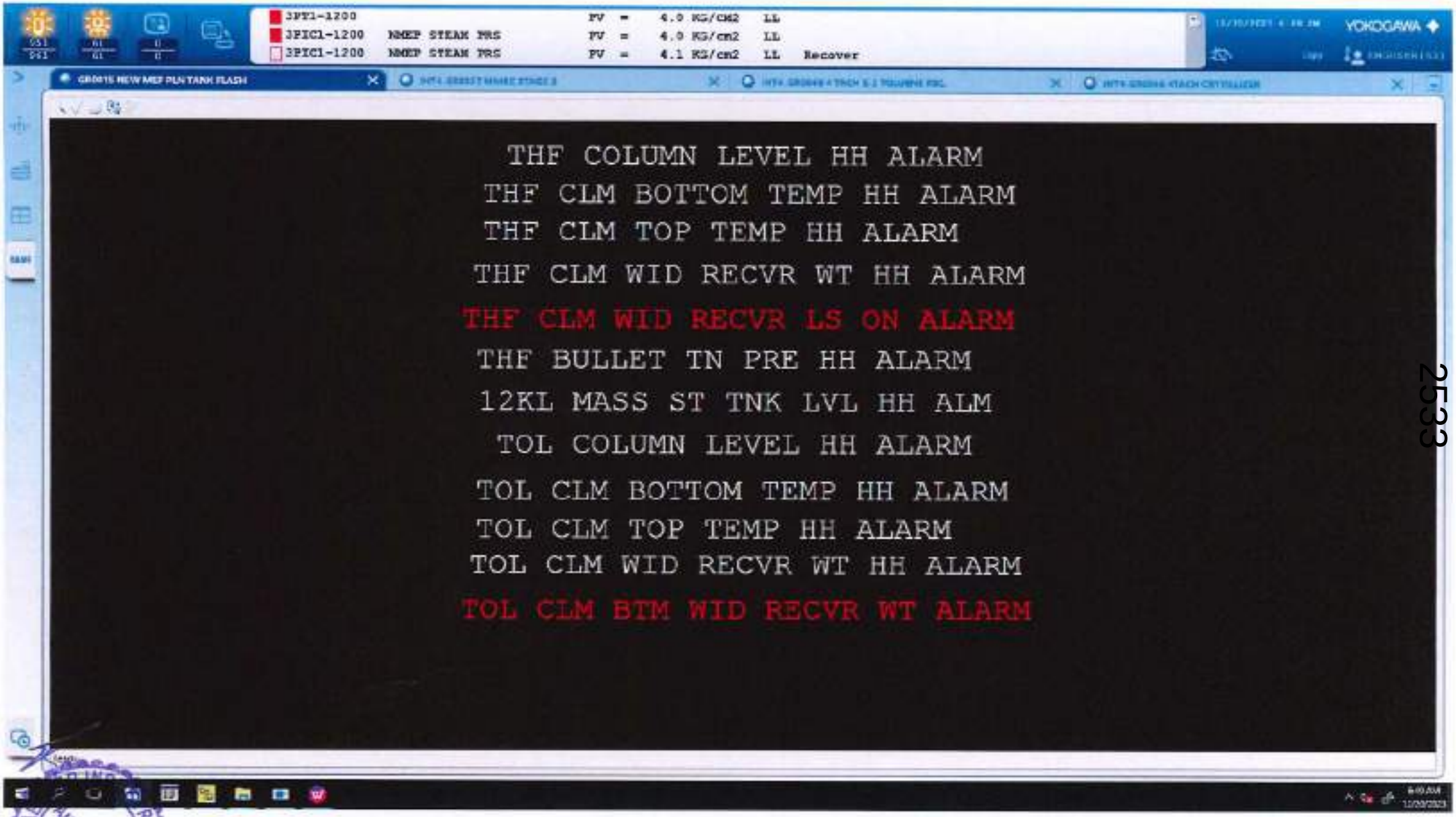
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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-1	56	15
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	Stream-3	172	
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	Stream-4	192	

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3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 NMEP STEAM PRS PV = 4.0 KG/cm2 LL
3PIC1-1200 NMEP STEAM PRS PV = 4.1 KG/cm2 LL Recover
YOKOGAWA
GR0015 NEW MEP PLN TANK FLASH
THF COLUMN LEVEL HH ALARM
THF CLM BOTTOM TEMP HH ALARM
THF CLM TOP TEMP HH ALARM
THF CLM WID RECVR WT HH ALARM
THF CLM WID RECVR LS ON ALARM
THF BULLET TN PRE HH ALARM
12KL MASS ST TNK LVL HH ALM
TOL COLUMN LEVEL HH ALARM
TOL CLM BOTTOM TEMP HH ALARM
TOL CLM TOP TEMP HH ALARM
TOL CLM WID RECVR WT HH ALARM
TOL CLM BTM WID RECVR WT ALARM

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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-1	67	16
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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : [illegible] Equipment TAG No : [illegible] Block : [illegible]			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	ok	✓		RAMESH
2	Check visual condition of flame element	ok	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		RAMESH
4	Visually check Gasket condition	checked	✓		RAMESH

Note:-

Checked by MD

Hardik
11/12/2013

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Checked By PD

J. Tandel

Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-1	70	17
	Stream-1	76	
	Stream-2	87	
	Stream-2	93	
Node 5	Stream-2	155	
	Stream-2	161	
Node 6	Stream-2	219	
	Stream-2	225	
Node 7	Stream-2	284	
	Stream-2	290	
Node 8	Stream-1	328	

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MONTHLY CONTROL VALVE STOCK CHECK SCHEDULE (PSM-F01)

SR NO.	PLANT NAME	TAG NO.	SERVICE	CONTROL VALVE OPENING STATUS FROM DCS				DATE	DONE BY	CHECK BY	REMARKS
				25%	50%	75%	100%				
1	Plant-4	3TIC1-4274	THF Column Temp. CV	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
2	Plant-4	3TIC1-4267	T.L. Column Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
3	Plant-4	2TIC1-4288	L.B Column Temp CV	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
4	Plant-4	3TIC1-4401	Fresh Clay Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
5	Plant-4	3TIC0-4424	Rose Distillation Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
6	SRP	3TIC0-4114	Cont Clam 1 Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
7	SRP	3TIC1-2115	Cont. Clam 2 Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
8	SRP	3TIC0-4143	Cont. Clam 3 Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-
9	SRP	3TIC0-4155	Cont Clam 4 Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	[illegible]	-

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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-3	104	18

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Sign. & Date: 19/12/2023
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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT3-2230
Range	0 TO 2000 Kg/h
Accuracy	±0.5 %
Calibration date	19/12/2023
Calibration due date	18/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H IXi-XtI	% Error of F.S. IXi-XtI / F.S. *100
0	4.0	4.00	00	0	0.00
500	8.0	8.04	505	5	0.25
1000	12.0	12.07	1009	9	0.45
1500	16.0	16.07	1509	9	0.45
2000	20.0	20.08	2010	10	0.50

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Manjeet Singh	Tejas Patel
Signature	Manjeet	

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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-3	111	19

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 11.12.2023 Equipment TAG No : [illegible] Block : [illegible]			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		RAMESH
4	Visually check Gasket condition	checked	✓		RAMESH

Note:-

Checked by MD

11/12/2023

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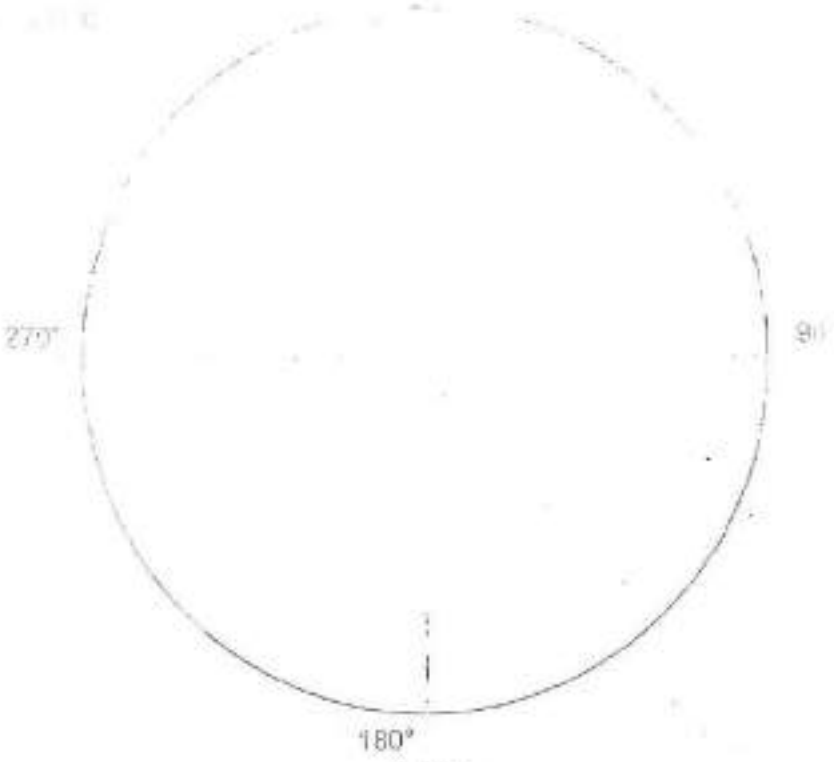
Checked By PD

11/12/2023.

Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-3	113	20

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PLAN

	0°	90°	180°	270°
TOP	5.95	5.90	5.94	5.90
MIDDLE	5.95	5.92	5.90	5.90
	5.92	5.90	5.92	5.92
BOTTOM	5.95	5.95	5.95	5.96

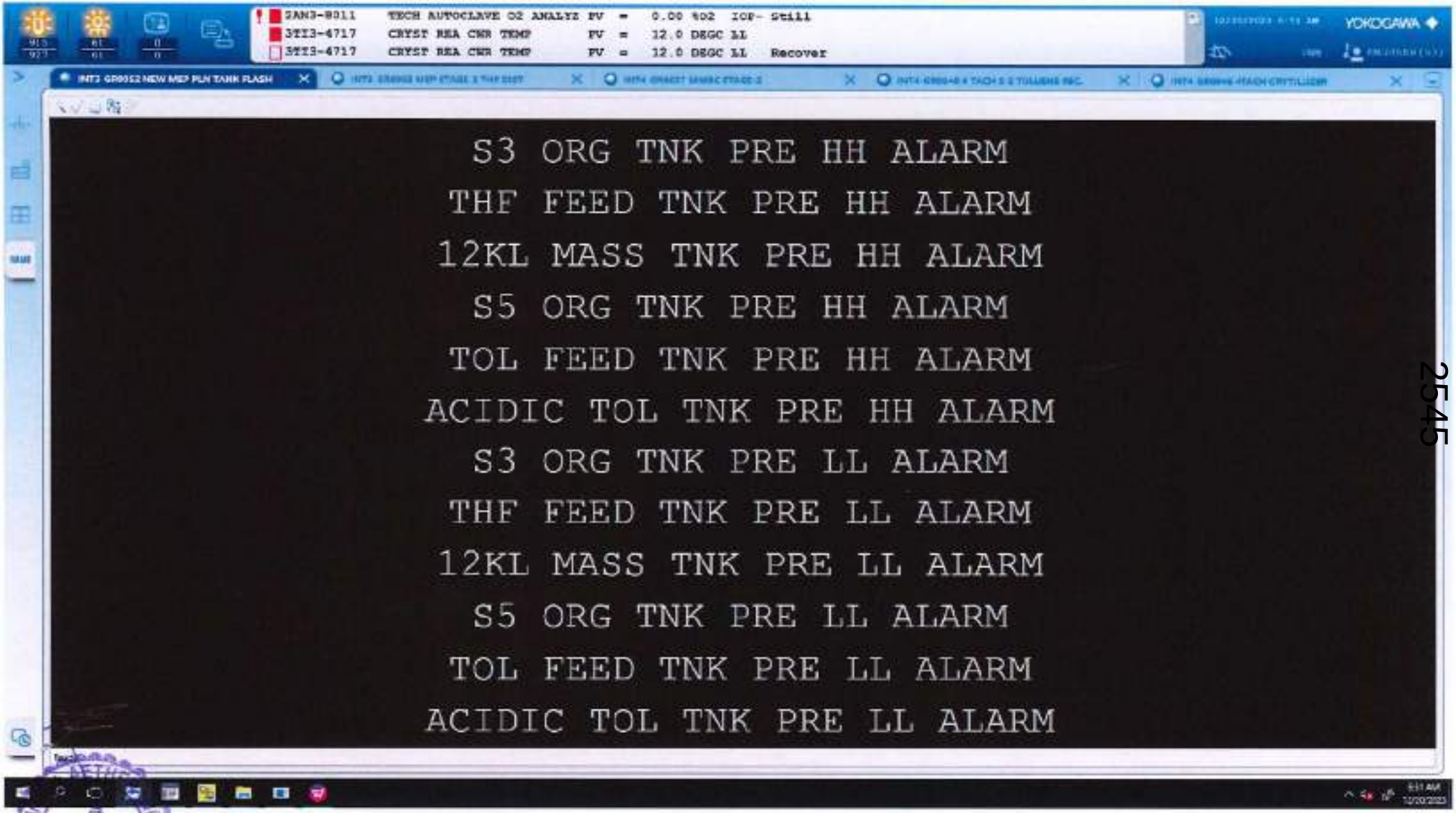
ELEVATION

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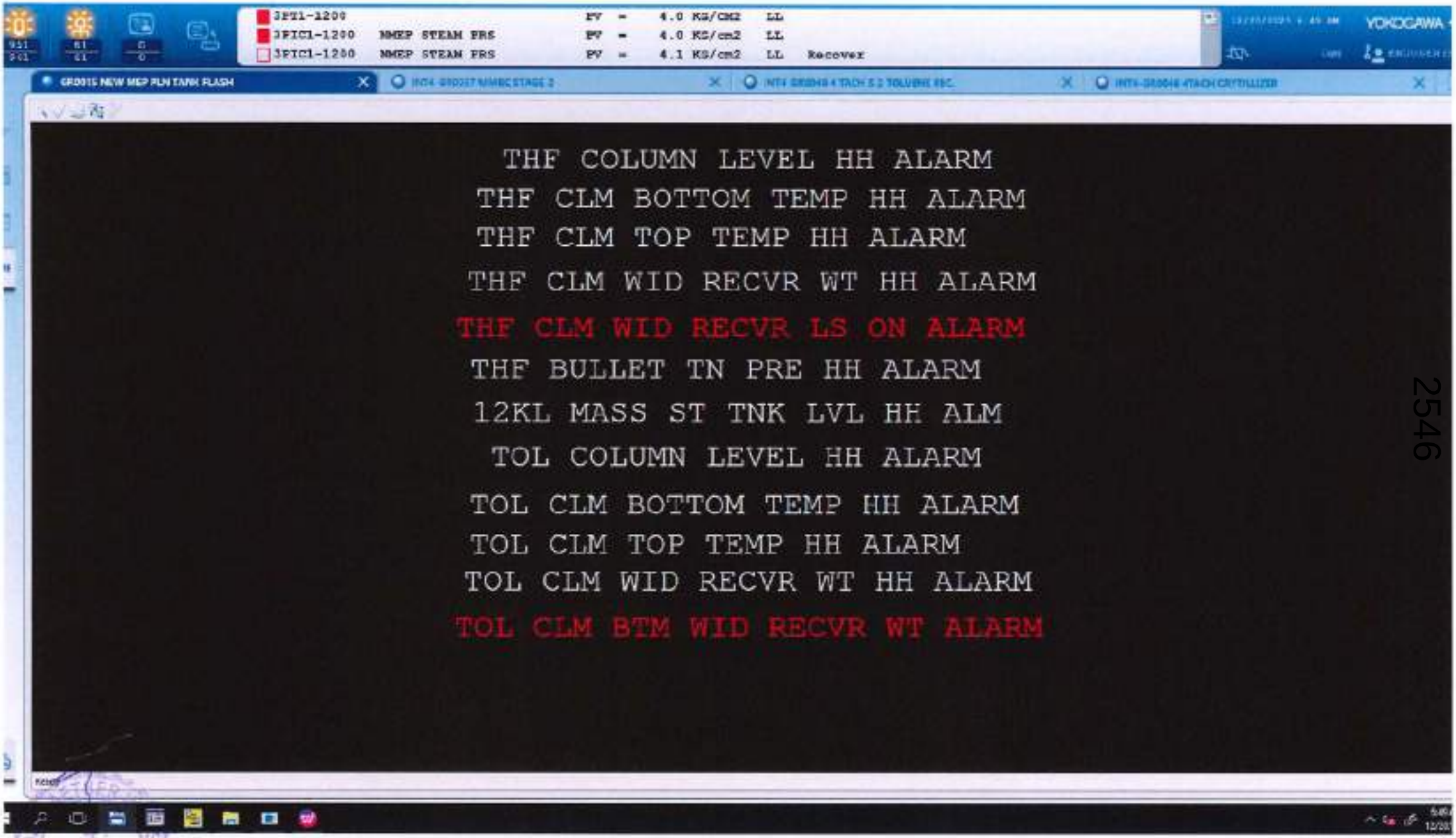
Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-4	115	21
	Stream-4	126	

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3AN3-8011 TECH AUTOCLAVE O2 ANALYZ PV = 0.00 %02 IOP- Still
3TI3-4717 CRYST REA CWR TEMP PV = 12.0 DEGC LL
3TI3-4717 CRYST REA CWR TEMP PV = 12.0 DEGC LL Recover
YOKOGAWA
INT3 GP0052 NEW MEP PLN TANK FLASH
S3 ORG TNK PRE HH ALARM
THF FEED TNK PRE HH ALARM
12KL MASS TNK PRE HH ALARM
S5 ORG TNK PRE HH ALARM
TOL FEED TNK PRE HH ALARM
ACIDIC TOL TNK PRE HH ALARM
S3 ORG TNK PRE LL ALARM
THF FEED TNK PRE LL ALARM
12KL MASS TNK PRE LL ALARM
S5 ORG TNK PRE LL ALARM
TOL FEED TNK PRE LL ALARM
ACIDIC TOL TNK PRE LL ALARM

2545


3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 NMEP STEAM PRS PV = 4.0 KG/cm2 LL
3PIC1-1250 NMEP STEAM PRS PV = 4.1 KG/cm2 LL Recover
YOKOGAWA
GR0015 NEW MEP RUN TANK FLASH
THF COLUMN LEVEL HH ALARM
THF CLM BOTTOM TEMP HH ALARM
THF CLM TOP TEMP HH ALARM
THF CLM WID RECVR WT HH ALARM
THF CLM WID RECVR LS ON ALARM
THF BULLET TN PRE HH ALARM
12KL MASS ST TNK LVL HH ALM
TOL COLUMN LEVEL HH ALARM
TOL CLM BOTTOM TEMP HH ALARM
TOL CLM TOP TEMP HH ALARM
TOL CLM WID RECVR WT HH ALARM
TOL CLM BTM WID RECVR WT ALARM

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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-4	122	22

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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FTI-2232
Range	0 TO 2420 KG/H
Accuracy	± 0.5 %
Calibration date	19/12/2023
Calibration due date	18/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H IXi-XtI	% Error of F.S. IXi-XtI / F.S. *100
0	4.0	4.00	0	0	0.00
605	8.0	8.04	612	7	0.28
1210	12.0	12.06	1220	10	0.41
1815	16.0	16.07	1826	11	0.45
2420	20.0	20.06	2430	10	0.41

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Mrunmayi Singh	Jeevan Patel
Signature	Mrunmayi	

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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-4	127	23

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 15/12/2023 Equipment TAG No : CM1-FA-01 Block : CM1-UM			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performe by
1	Check All nuts and bolts for tightness	OK	✓		ASAY
2	Check visual condition of flame element	OK	✓		ASAY
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleaned	✓		ASAY
4	Visually check Gasket condition	Checked	✓		ASAY
Note:-					

Checked by MD

15/12/2023

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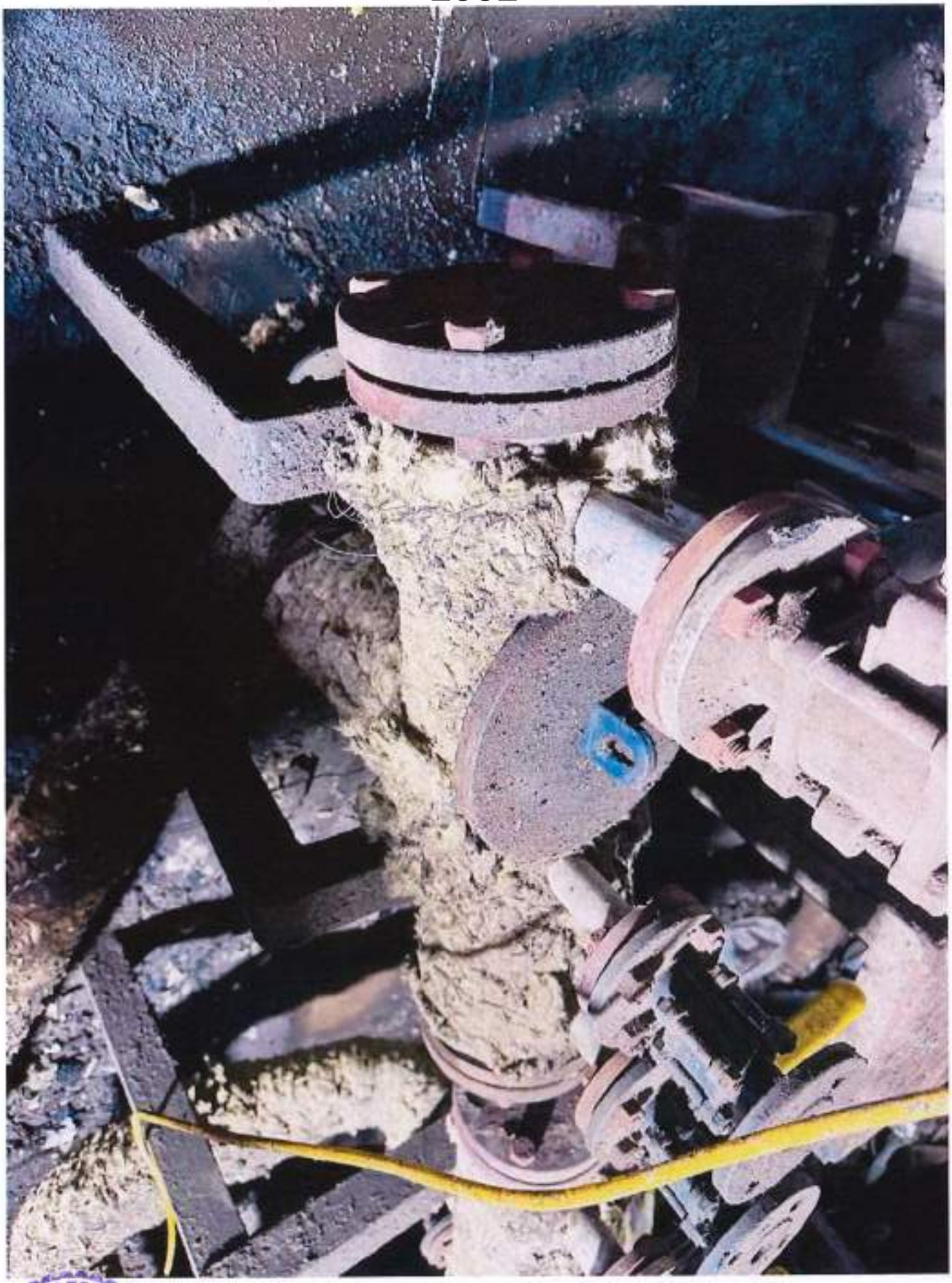
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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-4	128	24

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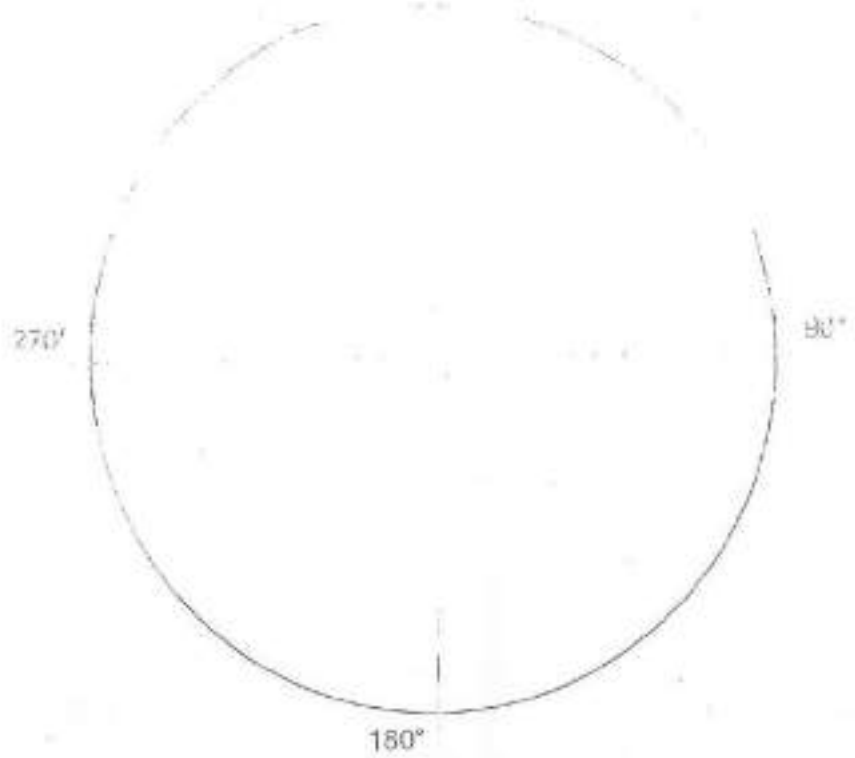
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Node	Stream	Sr.No.	Page Ref. No.
Node 4	Stream-4	130	25

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PLAN

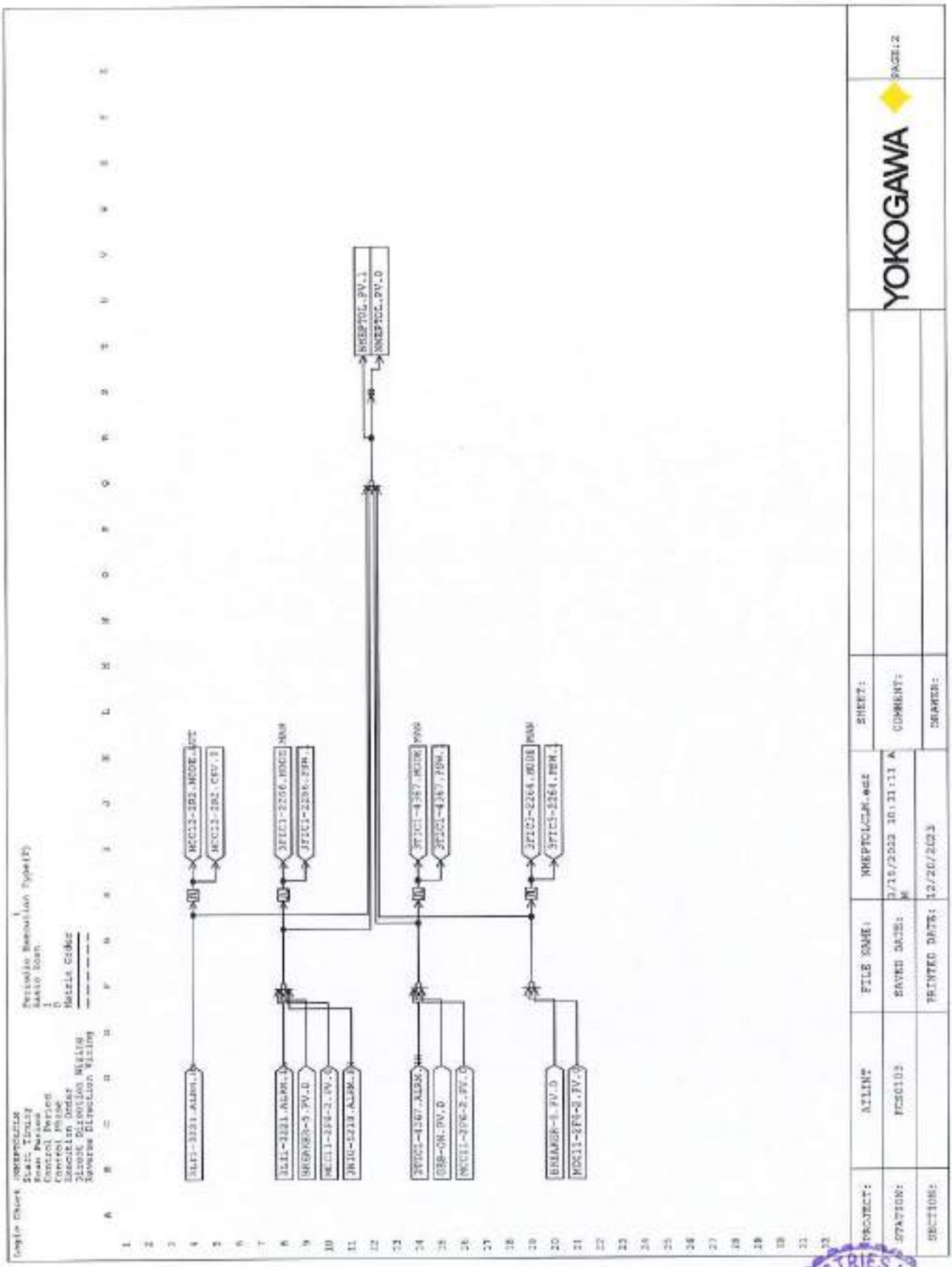
	0°	90°	180°	270°
TOP	5.90	5.91	5.90	5.90
MIDDLE	5.90	5.92	5.91	5.95
BOTTOM	5.95	5.95	5.95	5.95

ELEVATION

Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-1	133	26
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	Stream-1	142	
	Stream-2	145	
	Stream-2	146	
	Stream-2	147	
	Stream-2	149	
	Stream-2	153	
	Stream-2	154	
	Stream-2	157	
	Stream-2	159	
	Stream-2	160	
	Stream-3	169	
	Stream-3	170	
	Stream-3	173	
	Stream-3	175	
	Stream-4	182	
	Stream-4	189	
	Stream-4	191	

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Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-1	140	27
Node 5	Stream-1	143	27

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 10/12/2023 Equipment ID No : C-0172- 2110 Block : UT-1M	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	OK	RAMESH
2	Check visually foundation of the pump	OK	RAMESH
3	Check frame bolting properly tight	OK	RAMESH
4	Check the coupling condition	OK	RAMESH
5	Check for any abnormal noise and vibrations.	OK	RAMESH
6	Check oil level in the bearing housing	OK	RAMESH
7	Check spider condition	OK	RAMESH
8	Check the coupling guard properly fitting	OK	RAMESH
9	Check all nuts and bolts of pump for tightness	OK	RAMESH
10	Check any leakages found from mechanical seal or gland	OK	RAMESH

Checked by :

10/12/2023

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 10/12/2017 Equipment ID No : Block :	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	ok	RAMESH
2	Check visually foundation of the pump	ok	RAMESH
3	Check frame bolting properly tight	ok	RAMESH
4	Check the coupling condition	ok	RAMESH
5	Check for any abnormal noise and vibrations.	ok	RAMESH
6	Check oil level in the bearing housing	ok	RAMESH
7	Check spider condition	ok	RAMESH
8	Check the coupling guard properly fitting	ok	RAMESH
9	Check all nuts and bolts of pump for tightness	ok	RAMESH
10	Check any leakages found from mechanical seal or gland	ok	RAMESH

Checked by :

10/12/2017

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Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-2	152	28

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)	Date : 13/12/2022 Equipment TAG No : [illegible] Block : INT-04

S.No	Description	Remark	QURTERLY	HALF YEARLY	Performe by
1	Check All nuts and bolts for tightness	OK	✓		ASAY
2	Check visual condition of flame element	OK	✓		ASAY
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		ASAY
4	Visually check Gasket condition	Checked	✓		ASAY

Note:-

Checked by MD

13/12/2022

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13/12/2022

Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-3	177	29

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 16/12/2023 Equipment TAG No : [illegible] Block : [illegible]			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage	cleaned	✓		RAMESH
4	Visually check Gasket condition	checked	✓		RAMESH

Note:-

Checked by MD

16/12/2023

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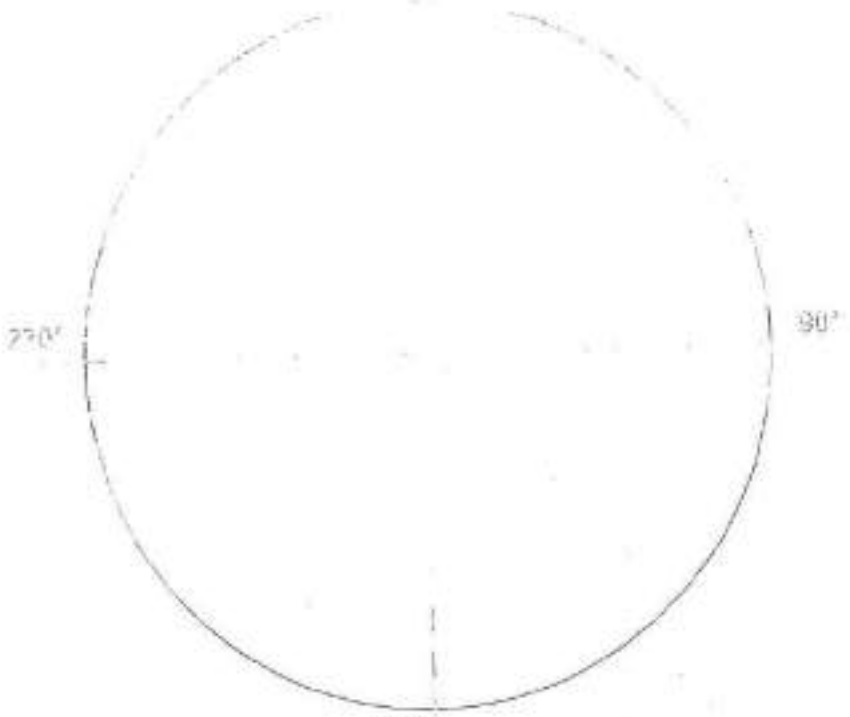
16/12/2023

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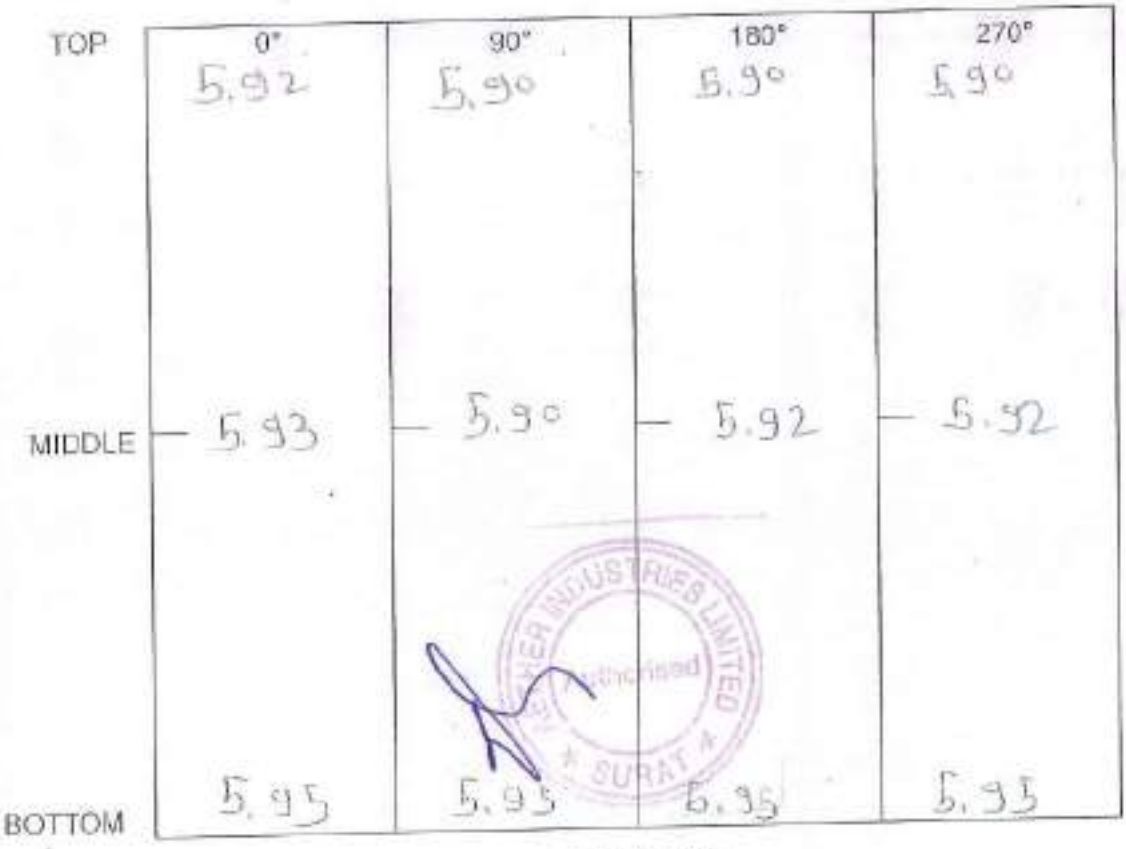
30

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2565



PLAN



ELEVATION

Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-4	188	31

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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT1-2266
Range	0 TO 2000 kg/h
Accuracy	± 0.5 %
Calibration date	19/12/2023
Calibration due date	18/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H IXi-XtI	% Error of F.S. IXi-XtI / F.S. *100
0	4.00	4.00	0	0	0.00
500	8.00	8.02	503	3	0.15
1000	12.00	12.05	1007	7	0.35
1500	16.00	16.05	1507	7	0.35
2000	20.00	20.07	2009	9	0.45

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Mumeet Singh	Yunus Patel
Signature	Mumeet	

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Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-4	193	32

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 10/12/2023 Equipment TAG No : AE/EN-03 Block : ENT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	ok	✓		AJAY
2	Check visual condition of flame element	ok	✓		AJAY
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		AJAY
4	Visually check Gasket condition	checked	✓		AJAY

Note:-

Checked by MD

10/12/2023

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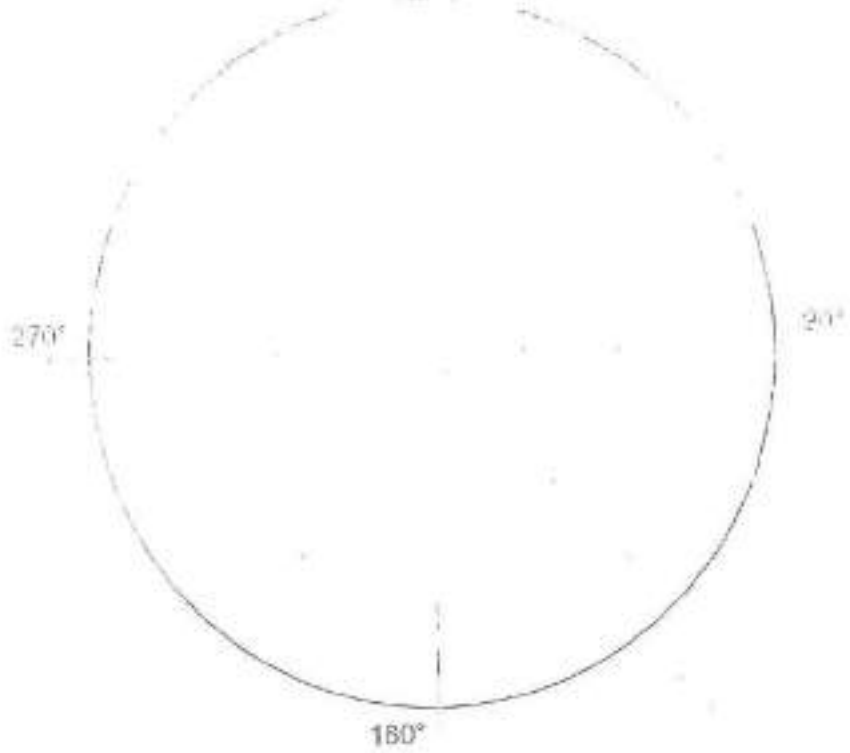
Checked By PD

Saurabh
10/12/2023

Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-4	195	33

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PLAN

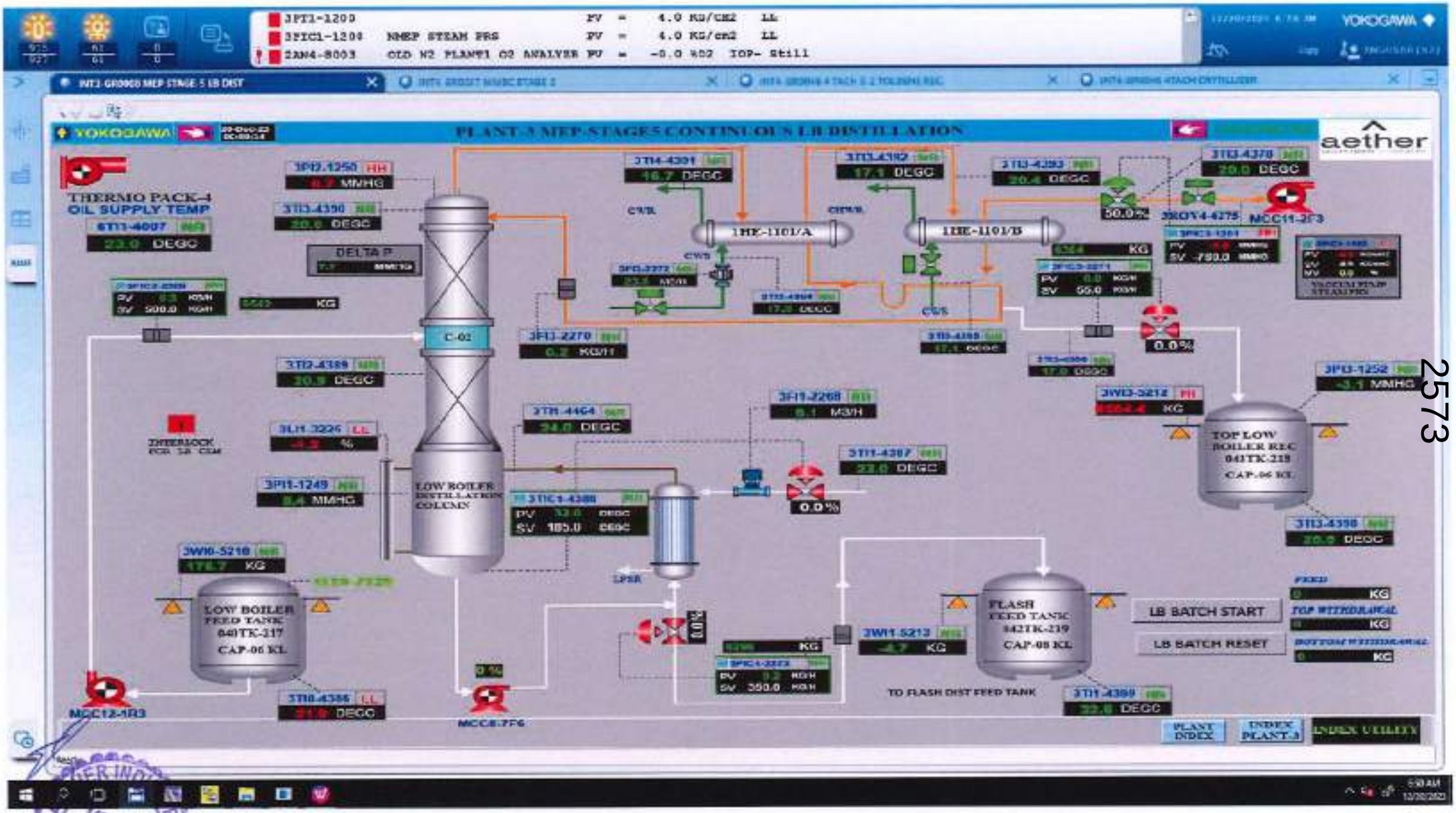
	0°	90°	180°	270°
TOP	5.90	5.91	5.90	5.92
	5.90	5.92	5.91	5.90
MIDDLE	5.92	5.92	5.90	5.91
BOTTOM	5.94	5.95	5.95	5.95

ELEVATION

Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-1	198	34

34



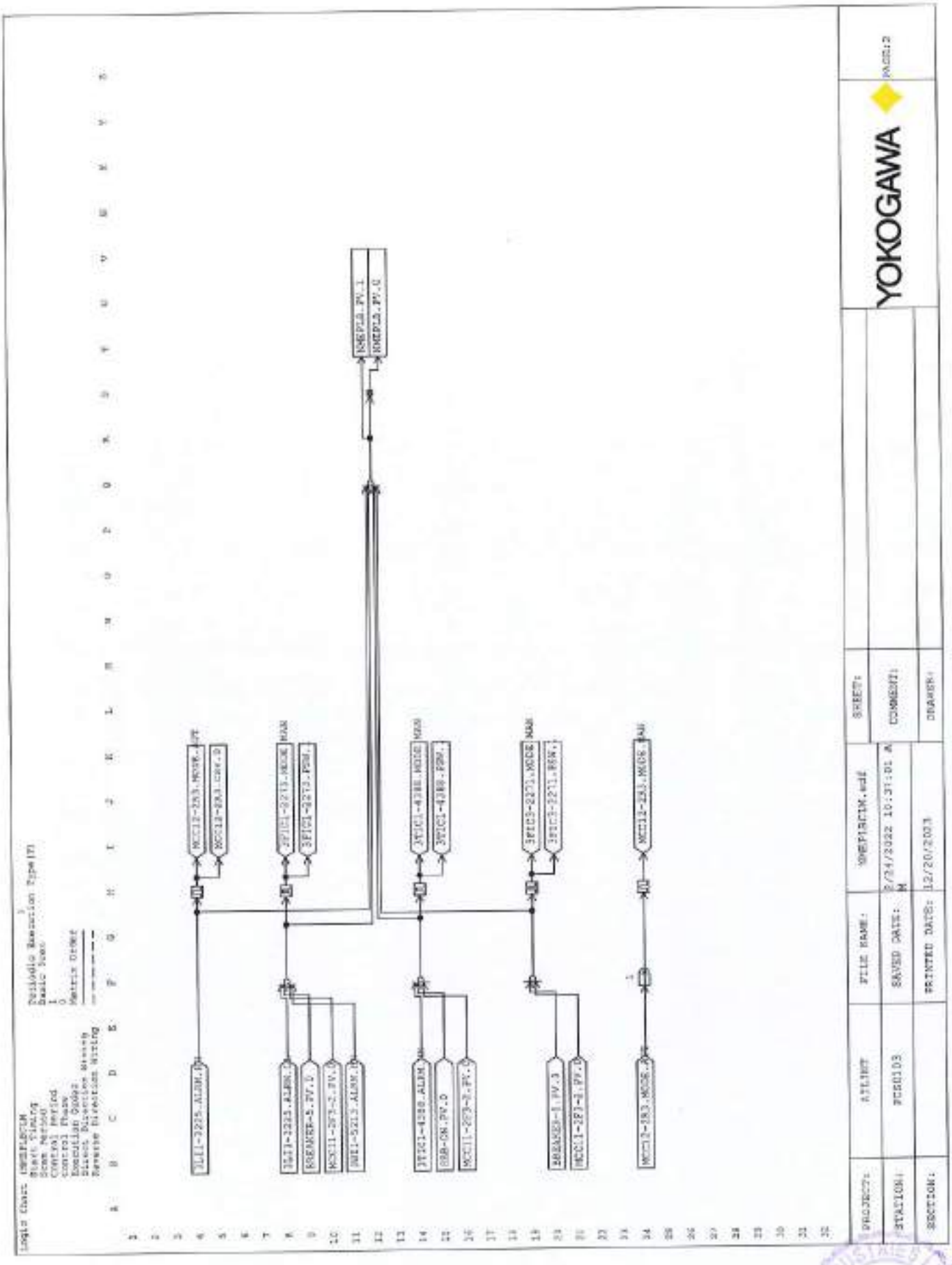

3PT1-1209 PV = 4.0 KG/CM2 LL
3PIC1-1208 NMEP STEAM PRS PV = 4.0 KG/cm2 LL
2AN4-8003 CID N2 PLANT1 O2 ANALYSE PV = -0.0 %02 IOP- Still
YOKOGAWA
PLANT-3 MEP-STAGE-5 CONTINUOUS LB DISTILLATION
aether
THERMO PACK-4
OIL SUPPLY TEMP
DELTA P
1HE-1101/A
1HE-1101/B
C-02
LOW BOILER DISTILLATION COLUMN
LOW BOILER FEED TANK 841TK-217 CAP-06 KL
FLASH FEED TANK 842TK-219 CAP-08 KL
TOP LOW BOILER REC 841TK-218 CAP-06 KL
TO FLASH DIST FEED TANK
LB BATCH START
LB BATCH RESET
MCC12-1R3
MCC8.7F6
MCC11-2F3
PLANT INDEX
INDEX PLANT-3
INDEX UTILITY

2573

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Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-1	199	35
	Stream-1	204	
	Stream-1	207	
	Stream-2	210	
	Stream-2	211	
	Stream-2	212	
	Stream-2	214	
	Stream-2	217	
	Stream-2	218	
	Stream-2	221	
	Stream-2	223	
	Stream-2	224	
	Stream-3	233	
	Stream-3	234	
	Stream-3	235	
	Stream-3	238	
	Stream-4	246	
	Stream-4	253	
	Stream-4	262	
	Stream-4	265	




Logic Chart: UNSPECIFIED
Start Timing
Scan Period
Control Period
Control Phase
Execution Order
Block Execution Method
Reverse Direction Wiring
Periodic Execution Type(T)
Basic Type
1
0
Matrix Order
YOKOGAWA
PROJECT:
STATION:
SECTION:
FILE NAME:
SAVED DATE:
PRINTED DATE:
SHEET:
COMMENT:
DRAWN:
12/20/2023

Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-1	205	36
	Stream-1	208	
	Stream-4	263	
	Stream-4	266	

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 15/12/2023 Equipment ID No : [illegible] Block : 3N1-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	Ok	Jaimin
2	Check visually foundation of the pump	OK	Jaimin
3	Check frame bolting properly tight	ok	Jaimin
4	Check the coupling condition	OK	Jaimin
5	Check for any abnormal noise and vibrations.	OK	Jaimin
6	Check oil level in the bearing housing	oil Makeup	Jaimin
7	Check spider condition	OK	Jaimin
8	Check the coupling guard properly fitting	OK	Jaimin
9	Check all nuts and bolts of pump for tightness	OK	Jaimin
10	Check any leakages found from mechanical seal or gland	OK	Jaimin

Checked by : 15/12/2023

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : [illegible] Equipment ID No : [illegible] Block : [illegible]	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	OK	Jaimin
2	Check visually foundation of the pump	OK	Jaimin
3	Check frame bolting properly tight	OK	Jaimin
4	Check the coupling condition	OK	Jaimin
5	Check for any abnormal noise and vibrations.	OK	Jaimin
6	Check oil level in the bearing housing	Oil level Makeup	Jaimin
7	Check spider condition	OK	Jaimin
8	Check the coupling guard properly fitting	OK	Jaimin
9	Check all nuts and bolts of pump for tightness	Tighten	Jaimin
10	Check any leakages found from mechanical seal or gland	OK	Jaimin

Checked by :

14/12/2017

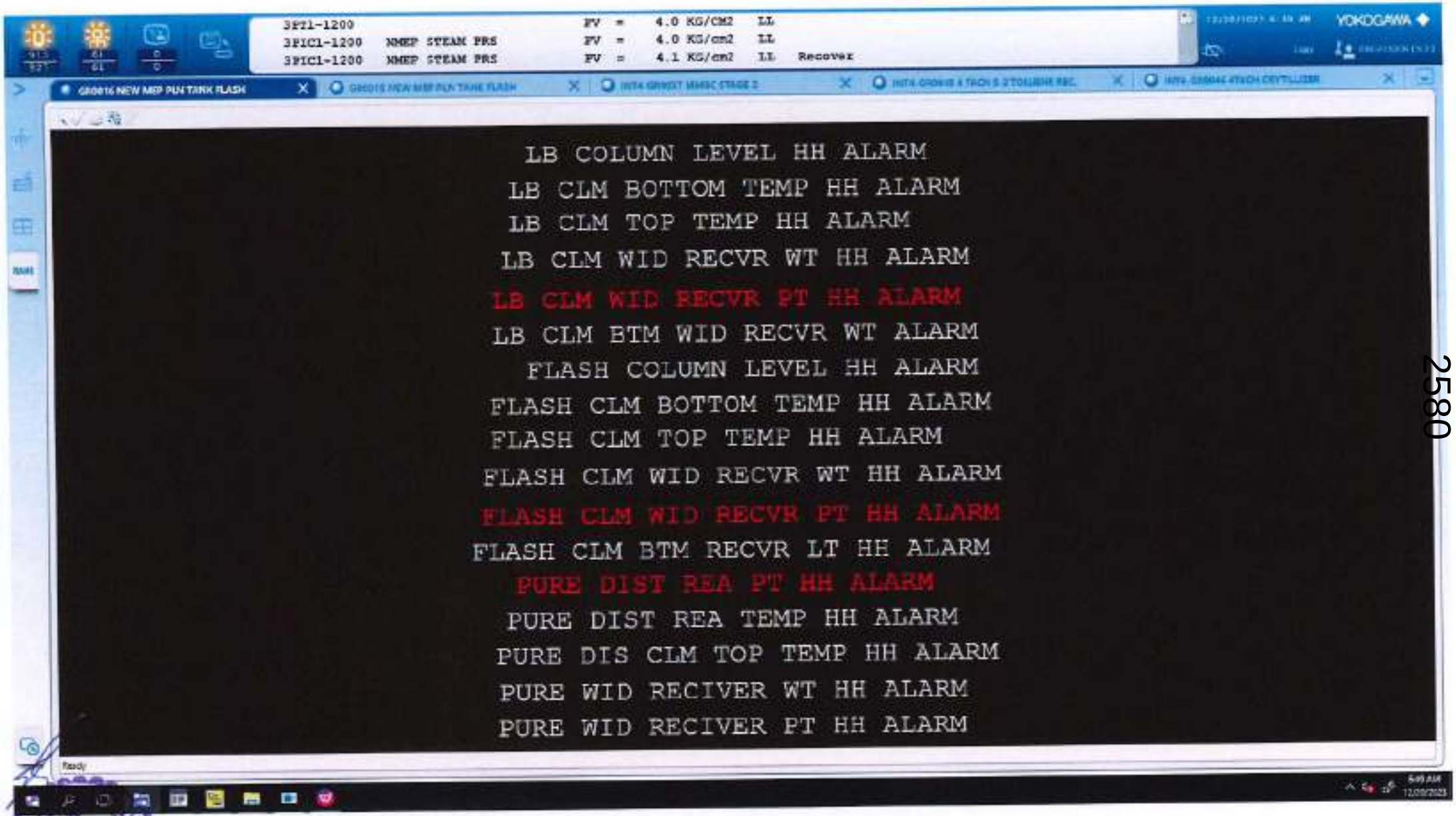
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Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-1	206	37
	Stream-1	209	
	Stream-2	213	
	Stream-2	216	
	Stream-2	220	
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Node 7	Stream-1	274	
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	Stream-2	281	
	Stream-2	285	
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	Stream-3	305	
Node 8	Stream-1	323	
	Stream-1	327	
	Stream-2	339	
	Stream-2	340	
	Stream-2	343	



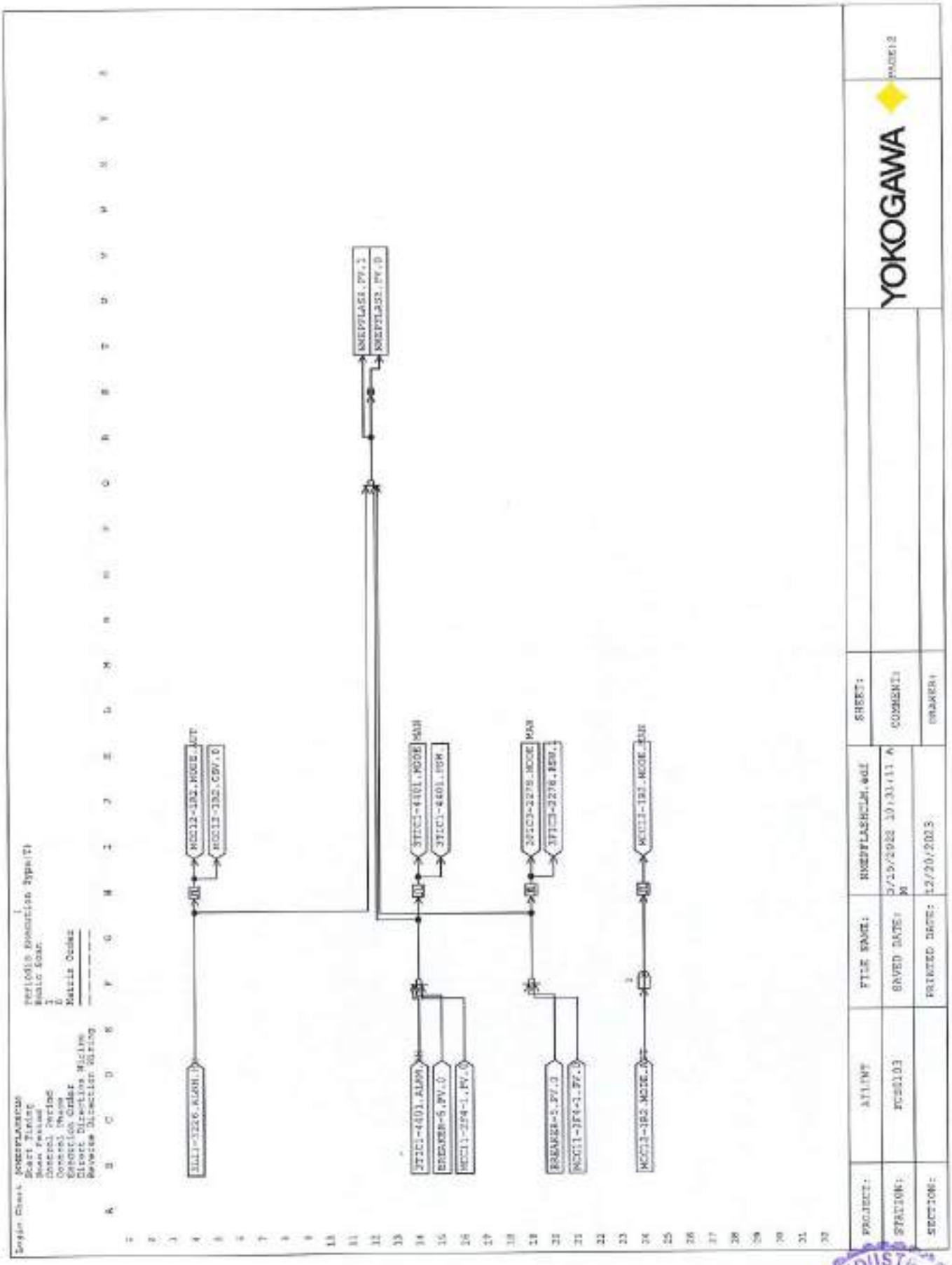

3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 MMEP STEAM PRS PV = 4.0 KG/cm2 LL
3PIC1-1200 MMEP STEAM PRS PV = 4.1 KG/cm2 LL Recover
YOKOGAWA
LB COLUMN LEVEL HH ALARM
LB CLM BOTTOM TEMP HH ALARM
LB CLM TOP TEMP HH ALARM
LB CLM WID RECVR WT HH ALARM
LB CLM WID RECVR PT HH ALARM
LB CLM BTM WID RECVR WT ALARM
FLASH COLUMN LEVEL HH ALARM
FLASH CLM BOTTOM TEMP HH ALARM
FLASH CLM TOP TEMP HH ALARM
FLASH CLM WID RECVR WT HH ALARM
FLASH CLM WID RECVR PT HH ALARM
FLASH CLM BTM RECVR LT HH ALARM
PURE DIST REA PT HH ALARM
PURE DIST REA TEMP HH ALARM
PURE DIS CLM TOP TEMP HH ALARM
PURE WID RECIVER WT HH ALARM
PURE WID RECIVER PT HH ALARM
Ready

2580

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Node	Stream	Sr.No.	Page Ref. No.
Node 7	Stream-1	272	38
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	Stream-2	276	
	Stream-2	277	
	Stream-2	279	
	Stream-2	282	
	Stream-2	283	
	Stream-2	286	
	Stream-2	288	
	Stream-2	289	
	Stream-3	298	
	Stream-3	299	
	Stream-3	300	
	Stream-3	306	
	Stream-3	314	



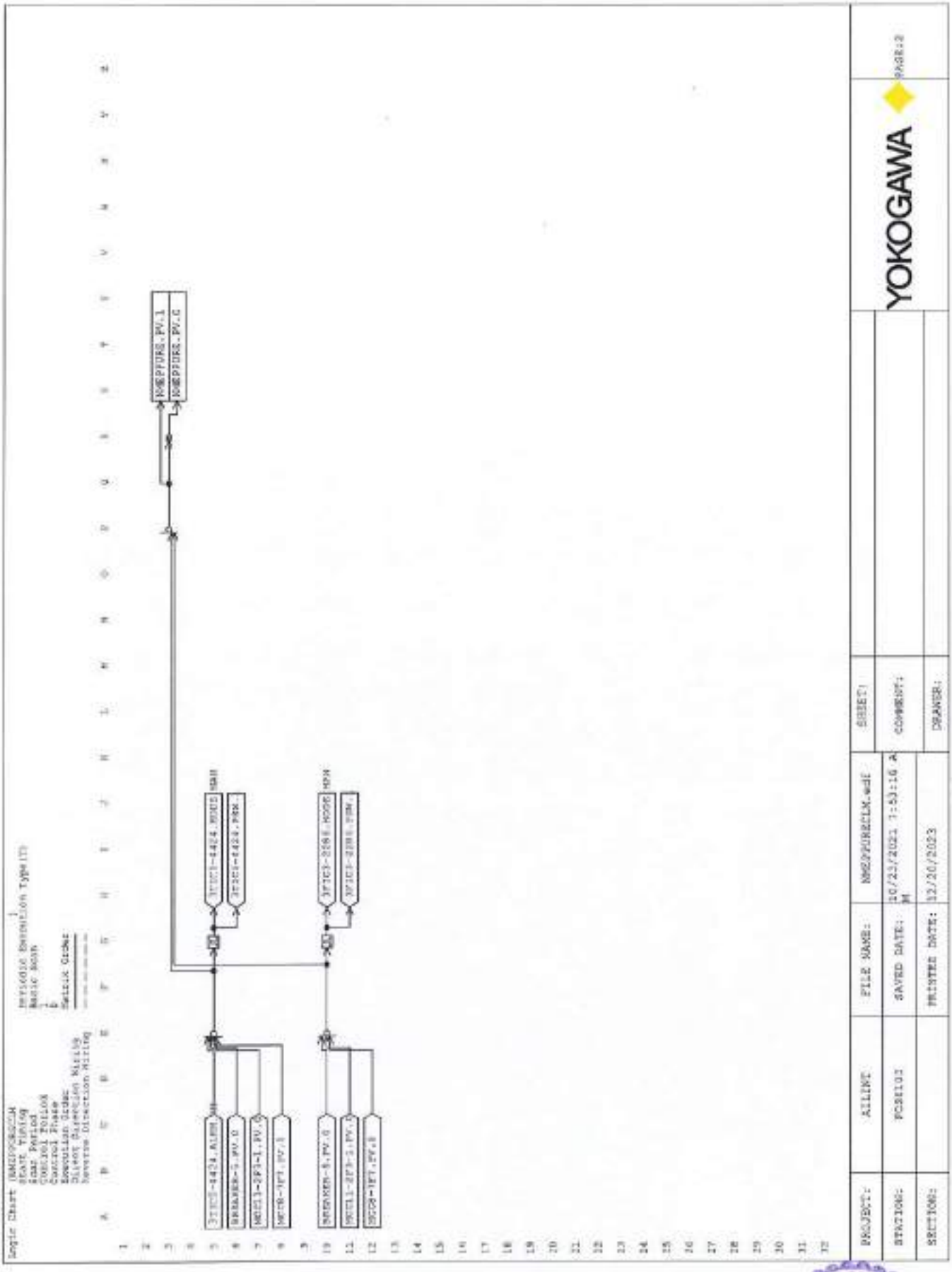


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Node	Stream	Sr.No.	Page Ref. No.
Node 8	Stream-1	320	39
	Stream-1	321	
	Stream-1	322	
	Stream-1	324	
	Stream-1	325	
	Stream-1	326	
	Stream-2	337	
	Stream-2	338	
	Stream-2	341	

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Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-3	241	40

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : Equipment TAG No : Block :			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		AJAY
2	Check visual condition of flame element	OK	✓		AJAY
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓		AJAY
4	Visually check Gasket condition	checked	✓		AJAY
Note:-					

Checked by MD

11/12/2017

AETHER INDUSTRIES LIMITED Ankleshwar SURAT

Checked By PD

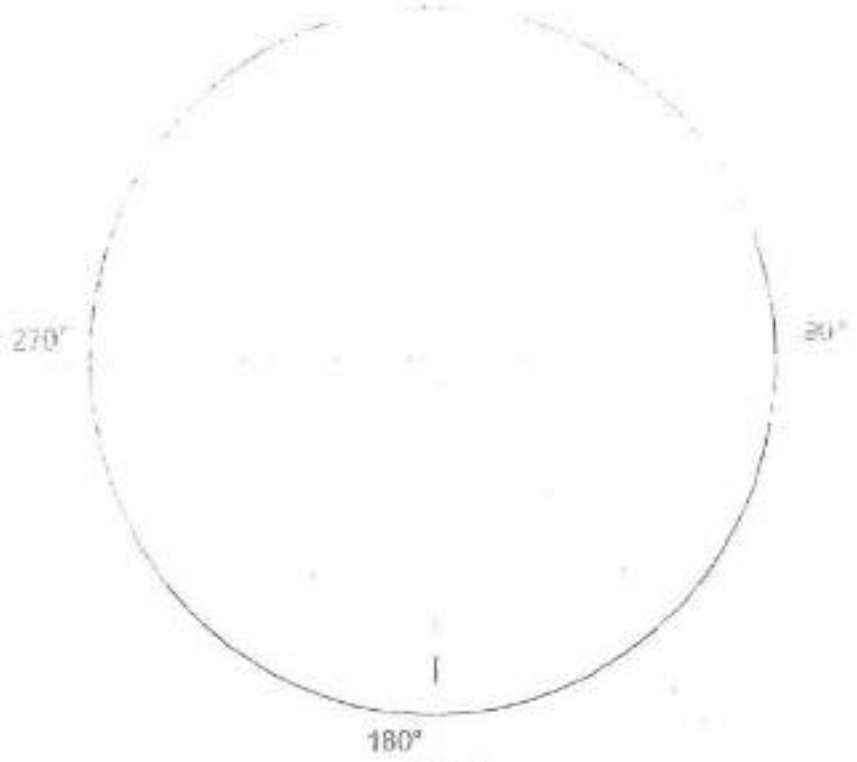
Saurabh
11/12/2017

Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-3	243	41
	Stream-4	256	

41

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2588



PLAN

	0°	90°	180°	270°
TOP	5.91	5.91	5.91	5.90
	5.90	5.90	5.90	5.91
MIDDLE	5.92	5.92	5.92	5.92
BOTTOM	5.95	5.95	5.95	5.95

ELEVATION

Node	Stream	Sr.No.	Page Ref. No.
Node 6	Stream-4	252	42

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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT1-2273
Range	0 TO 2500 KG/H
Accuracy	±0.5 %
Calibration date	19/12/2023
Calibration due date	18/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H IXi-XtI	% Error of F.S. IXi-Xti / F.S. *100
00	4.0	4.00	00	0	0.00
625	8.0	8.00	626	1	0.04
1250	12.0	12.01	1252	2	0.08
1875	16.0	16.01	1878	3	0.12
2500	20.0	20.03	2506	6	0.24

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Mumen't Singh	Tejas Patel
Signature	Mumen't	

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Node	Stream	Sr.No.	Page Ref. No.
Node 7	Stream-1	273	43

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 14/12/2023 Equipment ID No : Block :	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	OK	Ajay
2	Check visually foundation of the pump	OK	Ajay
3	Check frame bolting properly tight	OK	Ajay
4	Check the coupling condition	OK	Ajay
5	Check for any abnormal noise and vibrations.	OK	Ajay
6	Check oil level in the bearing housing	Oil Makeup	Ajay
7	Check spider condition	OK	Ajay
8	Check the coupling guard properly fitting	OK	Ajay
9	Check all nuts and bolts of pump for tightness	OK	Ajay
10	Check any leakages found from mechanical seal or gland	Leakage attend	Ajay

Checked by :

14/12/2023

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Sign & Date
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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 15/12/2023 Equipment ID No : Block : JWT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	OK	Sant
2	Check visually foundation of the pump	OK	Sant
3	Check frame bolting properly tight	OK	Sant
4	Check the coupling condition	OK	Sant
5	Check for any abnormal noise and vibrations.	OK	Sant
6	Check oil level in the bearing housing	Oil level Check	Sant
7	Check spider condition	Ok	Sant
8	Check the coupling guard properly fitting	OK	Sant
9	Check all nuts and bolts of pump for tightness	OK	Sant
10	Check any leakages found from mechanical seal or gland	OK	Sant

Checked by :

15/12/2023

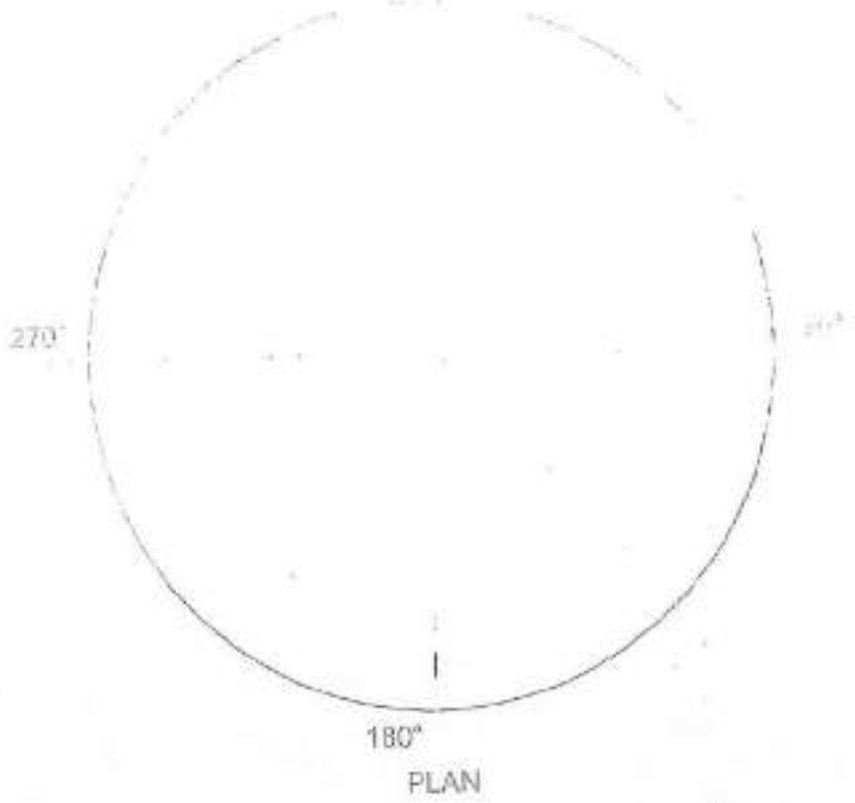
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Node	Stream	Sr.No.	Page Ref. No.
Node 7	Stream-3	303	44
	Stream-3	317	

44



2595



PLAN



ELEVATION

Node	Stream	Sr.No.	Page Ref. No.
Node 7	Stream-3	311	45
	Stream-3	312	
	Stream-3	313	

45



Sign. & Date
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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT3-2278
Range	0 TO 2000 KG/H
Accuracy	± 0.5 %
Calibration date	19/12/2023
Calibration due date	18/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H IXi-XtI	% Error of F.S. IXi-XtI / F.S. *100
00	4.0	4.0	00	00	0.00
500	8.0	8.0	500	00	0.00
1000	12.0	12.04	1006	06	0.30
1500	16.0	16.06	1507	07	0.35
2000	20.0	20.07	2008	08	0.40

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Manmeet Singh	Jayram Patel
Signature	Manmeet	

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AETHER INDUSTRIES LTD. * QA

Node	Stream	Sr.No.	Page Ref. No.
Node 8	Stream-2	344	46

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 10/12/2023 Equipment TAG No : Block : SMT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performe by
1	Check All nuts and bolts for tighiness	OK	✓		RAMESH
2	Check visual condition of flame element	OK	✓		RAMESH
3	Proper cleaning of flame element and Passage (With Nitrogen)	Cleaned	✓		RAMESH
4	Visually check Gasket condition	Checked	✓		RAMESH
Note:-					

Checked by MD

10/12/2023

Checked By PD

10/12/2023

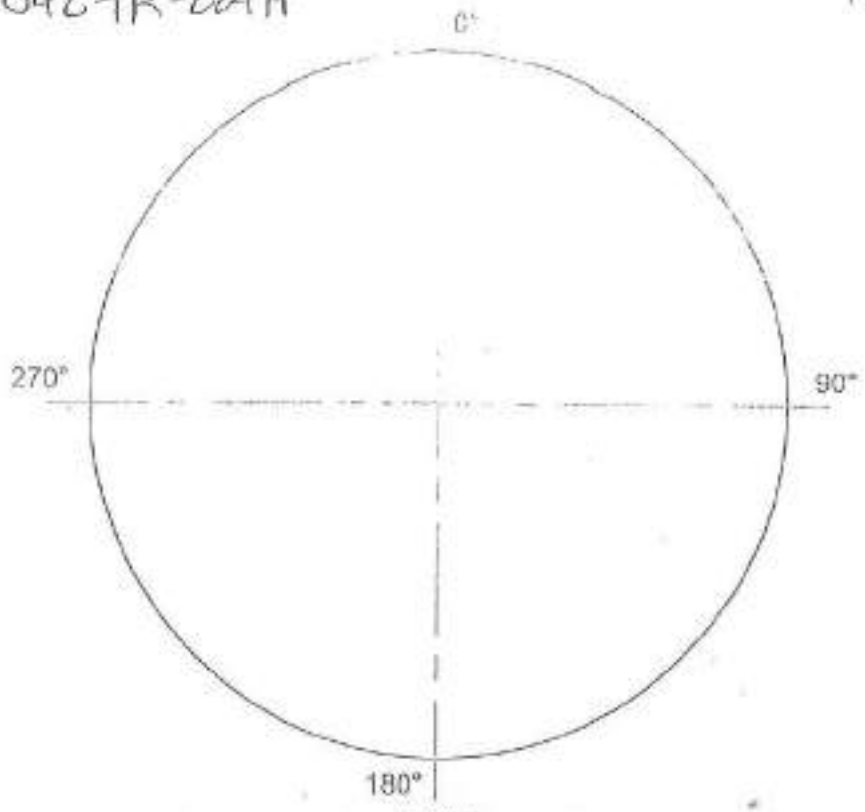
Node	Stream	Sr.No.	Page Ref. No.
Node 8	Stream-2	346	47

47



042-TR-224A

16/12/2023



PLAN

	0°	90°	180°	270°
TOP	5.95	5.90	5.92	5.90
MIDDLE	5.95	5.90	5.93	5.93
BOTTOM	5.95	5.92	5.95	5.95

ELEVATION

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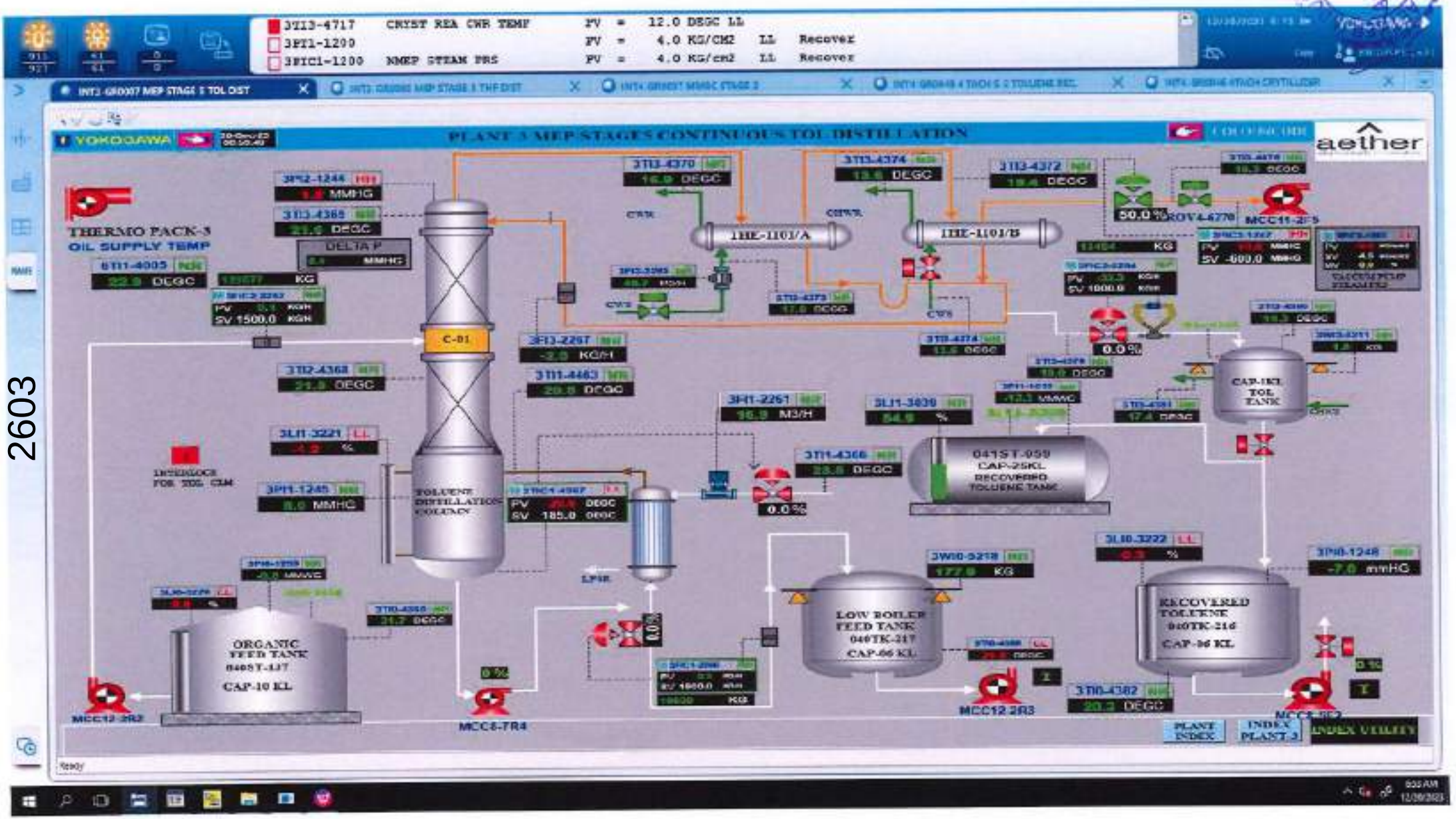
Node	Stream	Sr.No.	Page Ref. No.
Node 5	Stream-1	132	48

48



Authorised Signatory
SURAT LIMITED

2603



2604

HAZOP STUDY REPORT OF

MMBC PLANT

M/S AETHER INDUSTRIES LTD.,

SACHIN, SURAT

DECEMBER 2023

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NEXA
Process Safety Engineers

2605

AETHER INDUSTRIES LTD.,

SURAT

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HAZOP STUDY REPORT OF

MMBC PLANT

DECEMBER 2023

By

NEXA PROCESS SAFETY ENGINEERS

NEXA
Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat

NEXA PROCESS SAFETY ENGINEERS SURAT

Proprietor

13/12/2023

NEXA PROCESS SAFETY ENGINEERS

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for MMBC Plant.

Nexa Process Safety Engineers deputed Mr. Akhilkumar Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether’s safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for MMBC Project.
It has 13 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	MCT storage tank (040ST-145)
2.	THF storage tank (040ST-179)
3.	Grignard addition reaction reactor(043RT-083)
4.	Grignard reactor(042RT-086)
5.	Coupling reactor(042RT-089)
6.	Quenching reactor(041RT-095)
7.	Chlorination reactor(042RT-103)
8.	Chlorination reactor(042RT-104)
9.	solvent recovery reactor(041RT-106)
10.	Crude MMBC storage reactor(042RT-105)
11.	Final distillation reactor(041RT-107)
12.	Pure MMBC storage tank(041ST-160)
13.	HCl receiver for scrubber(040TK-252)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other’s ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.

5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be

subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

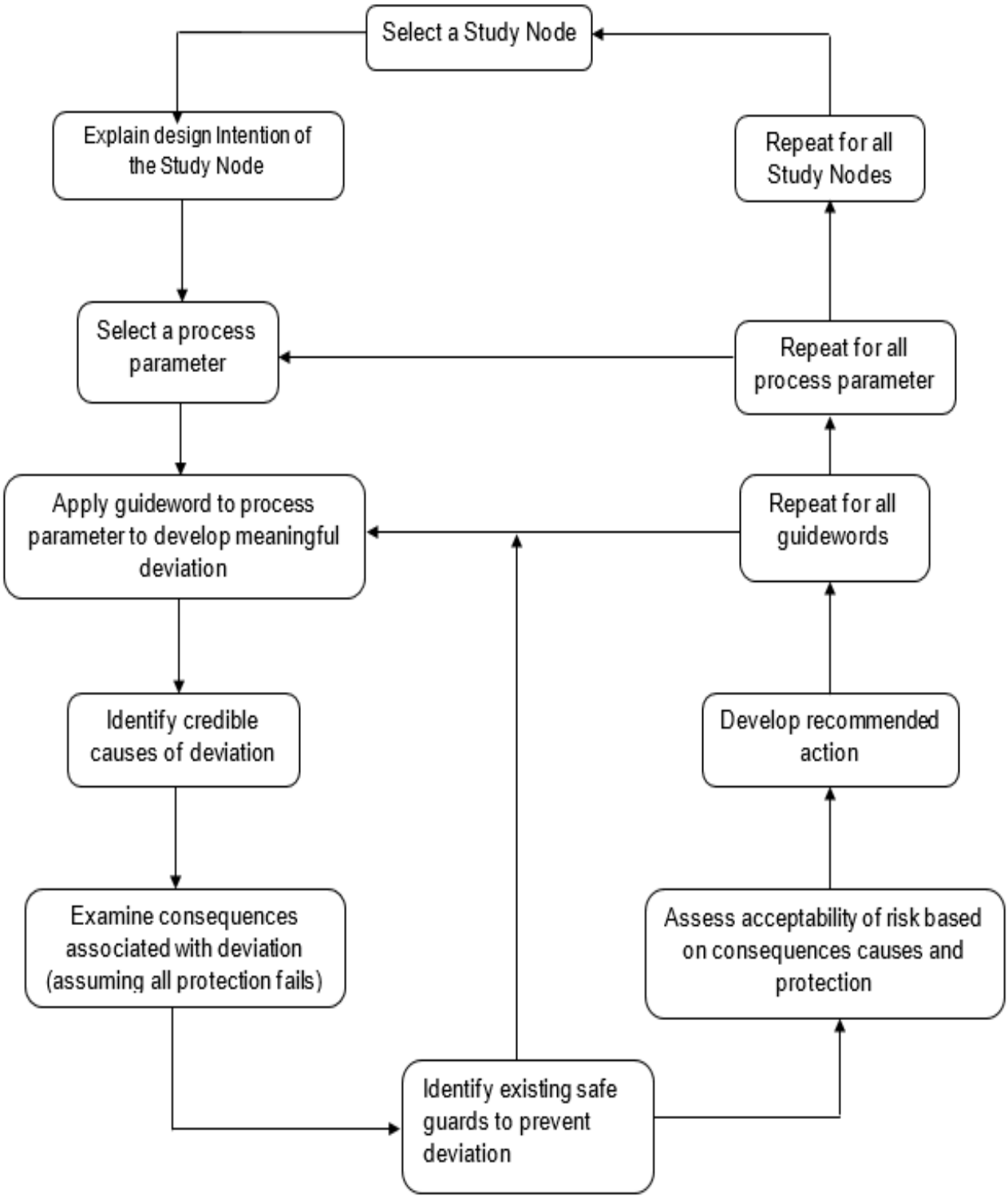
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	Provided at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. Akhilkumar Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. Akhilkumar Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

Node 1		Node Description : MCT storage tank (040ST-145)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Material loading and unloading in MCT storage tank**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Recommend to provide overload tripping on pump.
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.

Node 1		Node Description : MCT storage tank (040ST-145)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Double mechanical seal to be provide in pump.
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	1. Recommended to provide interlock to stop transferring pump at HH alarm value of LI & LS activation of storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH alarm value of LI of storage tank. 4.Flash alarm to be provided on LS activation of storage tank.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent		1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1.Flame arrestor PM to be performed as per pre-defined schedule.

Node 1		Node Description : MCT storage tank (040ST-145)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			line)		2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	1.PVRV PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	1.PVRV PM to be performed as per pre-defined schedule.
			N2 line manual valve pass		1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on	1.Double manual valve to be provide in N2 line.

Node 1		Node Description : MCT storage tank (040ST-145)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					tank.	
			N2 PRV failure		1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	1.PM to be performed of PRV as per predefined schedule.
3	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.

Node 2		Node Description : THF storage tank (040ST-179)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Material loading and unloading in THF storage tank**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 2		Node Description : THF storage tank (040ST-179)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Recommend to provide overload tripping on pump.
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.

Node 2		Node Description : THF storage tank (040ST-179)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Double mechanical seal to be provide in pump.
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	1. Recommended to provide interlock to stop transferring pump at HH alarm value of LI & LS activation of storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH alarm value of LI of storage tank. 4.Flash alarm to be provided on LS activation of storage tank.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.

Node 2		Node Description : THF storage tank (040ST-179)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	1.PVRV PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	1.PVRV PM to be performed as per pre-defined schedule.
			N2 line manual valve pass		1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	1.Double manual valve to be provide in N2 line.

Node 2		Node Description : THF storage tank (040ST-179)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			N2 PRV failure		1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	1.PM to be performed of PRV as per predefined schedule.
3	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.

Node 3		Node Description : Grignard addition reaction reactor(043RT-083)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**MCT charging in grignard addition reactor (043RT-083)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 3		Node Description : Grignard addition reaction reactor(043RT-083)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the MCT transferring line ROV at HH value of PT of the reactor.and after 20 sec MCT transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	1.Upper limit of the totalizer to be freeze.
2	Pressure	High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6bar.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the MCT transferring line ROV at HH value of PT of the reactor.and after 20 sec MCT transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.
3	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.MCT charging line ROV air failed safe position is air failed to closed condition.
Stream-2		**THF charging in grignard addition reactor (043RT-083)**				

Node 3		Node Description : Grignard addition reaction reactor(043RT-083)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	PM of flame arrestor to be performed as per predefined schedule.
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	1.Upper limit of the totalizer to be freeze.
2	Pressure	High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6bar.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.

Node 3		Node Description : Grignard addition reaction reactor(043RT-083)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	PM of flame arrestor to be performed as per predefined schedule.
3	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.THF charging line ROV air failed safe position is air failed to closed condition.
Stream-3		**Mixing in grignard addition reactor (043RT-083)**				
1	Pressure	High	N2 line manual valve pass/Left open due to human error	Reactor may pressurise	1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	1.Double valve to be provided in N2 supply line.
			Human error(Manual vent line valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	1. Vent line valve should be locked open. 2.Flash alarm to be provide on HH value of PT of the reactor.
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	PM of flame arrestor to be performed as per predefined schedule.
2	Temperature	High	Human error(Steam supply line valve open)	Temperature rise may possible in reactor	1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	1.Steam line to be blinded to avoid human error.
3	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before	1.Spill kit to be provide to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used prevent gasket leakage.

Node 3		Node Description : Grignard addition reaction reactor(043RT-083)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					start up. 4.150 class flange is used. 5. LI is available in the reactor.	
			Reactor bottom valve passed/leakage		1.Compatible MOC of valve is used at bottom of the reactor.	1.Double manual valve to be provided at bottom of the reactor.
			Reactor Leakage		Reactor MOC is compatible with material.	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.

Node 4		Node Description : Grignard reactor(042RT-086)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Mg turnings charging into grignard reactor(042RT-086)**				
1	Quantity/Flow	No/Less	Human Error (Spillage)	No HSE hazard	1. Full body air supply suit is wear by person during charging. 2. Trained manpower will be deputed for this activity. 3. Hopper with valve will be used for charging.	1. Spill kit to be provided to contain spillage. 2. Area barrication to be done to restrict man movement during charging.
Stream-2		**(THF+MCT) addition in grignard reactor(042RT-086) from grignard addition reactor(043RT-083)**				
1	Quantity/Flow	No/Less	Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3.Fire extinguisher and fire	1. Flange guard to be provided on all flanges. 2.Compatible gasket to be used.

Node 4		Node Description : Grignard reactor(042RT-086)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					hydrant point is provided in near by area. 4.All electrical installation are flameproof as per HAC classification.	
			Human error (Vent line valve not opened)	Reactor may implode	1. SOP is available to open vent valve before starting transferring activity. 2. compound PT is available in the grignard addition reactor with low and low low alarms.	1. Vent line valve should be critical locked open condition with tag.
			Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation. 2.Material having no chocking property.	1.Flow meter PM to be performed as per predefined schedule.
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	1. Upper limit of the flow meter & totaliser to be freeze. 2. Flash alarm to be provided at HH temperature of reactor TI. 3. Interlock to be provided to closed addition CV at HH temperature of reactor.

Node 4		Node Description : Grignard reactor(042RT-086)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	1.Flow meter PM to be performed as per predefined schedule.
2	Pressure	High	Human error (Vent line/vapour line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3.RD is available on reactor for overpressure protection.	1. Recommended to provide interlock to closed addition CV at high high alarm of PT of the reactor. 2. Vent line valve should be critical locked open with tag. 3.Recommend to provide interlock to closed the steam TCV at HH pressure of the reactor. 4.Flash alarm to be provide on HH value of PT of the reactor.
			Human error (Vent line of catch pot not open)		1.PT is available in catch pot with high and high high alarm. 2.RD is available on reactor for overpressure protection.	1.Flash alarm to be provide on HH value of PT of the catch pot. 2. Recommended to provide interlock to closed addition CV at high high alarm of PT of the catch pot.
			Flame arrestor chocked		PM of flame arrestor is performed before startup.	PM of flame arrestor to be done as per predefined schedule.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.

Node 4		Node Description : Grignard reactor(042RT-086)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition.	1.Double valve to be provided in N2 supply line.
3	Temperature	High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	1.PM of critical instruments to be performed ass per predefined schedule.

Node 4		Node Description : Grignard reactor(042RT-086)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
			Fast addition rate of THF+MCT		Flowmeter & totaliser is available in the addition line.	1.Upper limit of flowmeter and totaliser to be freeze. 2.Interlock to be provide that at HH temperature of reactor THF+MCT line addition CV to be stop. 3.Flash alarm to be provide on HH temperature of the reactor.
4	Level	Low	Line leakage		1. Line testing done before start-up. 2. Compatible	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all

Node 4		Node Description : Grignard reactor(042RT-086)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					gasket is used.	flanges.
5	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.THF + MCT addition line CV air failed safe position to be air failed to closed condition.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	1.Steam TCV to be closed in case of agitator stop/trip. 2.THF+MCT addition line CV to be closed in case of agitator stop/trip.

Node 5		Node Description : Coupling reactor(042RT-089)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**THF charging in Coupling reactor(042RT-089)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 5		Node Description : Coupling reactor(042RT-089)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor. And after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	PM of flame arrestor to be performed as per predefined schedule.
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	1.Upper limit of the totalizer to be freeze.
2	Pressure	High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.

Node 5		Node Description : Coupling reactor(042RT-089)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					up to 6bar.	
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	PM of flame arrestor to be performed as per predefined schedule.
3	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.THF charging line ROV air failed safe position is air failed to closed condition.
Stream-3		**CO2 addition in coupling reactor(042RT-089)**				
1	Quantity/Flow	No/Less	Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation.	2.Flow meter PM is performed as per predefined schedule.
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CO2 addition line ROV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Brine supply provision is available in jacket of the reactor to control temperature. 5. Interlock is provided to closed addition ROV at HH temperature	1.Flash alarm to be provide at HH temperature of reactor TI. 2. Upper limit of the flow meter & totaliser to be freezed as per process requirement.

Node 5		Node Description : Coupling reactor(042RT-089)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					of reactor.	
2	Pressure	High	CO_2 supply pressure high	Reactor may pressurize	1. CO_2 PRS system available to supply required pressure. 2. PCV available to supply CO_2 pressure in coupling reactor. 3. ROV is available in the CO_2 supply line. 4. PT is available in reactor with high and high high alarm. 5. Interlock is available to close ROV and PCV in case of high high pressure of reactor. 6. PT is available in the CO_2 supply line with high and high high alarms. 7. Interlock is also available to close ROV and PCV of CO_2 supply line on high high value of CO_2 supply line PT.	1.Flash alarm to be provide on high high value of PT of coupling reactor. 2.Flash alarm to be provide on high high value of PT of CO_2 supply line of coupling reactor.

Node 5		Node Description : Coupling reactor(042RT-089)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
3	Temperature	High	CO2 supply pressure high	Exotherm may possible in reactor	1. TI is available in the reactor with high and high high alarms. 2. Interlock is available to close ROV & PCV of CO2 supply line on high high value of TI of the reactor. 3. ROV & PCV is available in the CO2 supply line. 4. For high supply pressure safeguards, refer high pressure scenario. 5. Interlock is available to open the brine supply line ROV of jacket of the reactor at HH value of TI of the reactor. 6.Interlock is available to open the brine return line ROV of tube bundle at HI value of TI of of reactor.	1.Flash alarm to be provided on HH value of TI of the reactor.
			Human error(Manual valve of steam supply line left open/passed)	Exotherm may possible in reactor	1.Trained manpower is deputed for operation and ensure proper line up before startup.	1.Steam line to be blinded to avoid human error.
4	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air	1.CO2 addition line ROV & PCV air failed safe position is air failed to closed condition. 2. Brine supply line

Node 5		Node Description : Coupling reactor(042RT-089)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					compressor running indication on DCS is available.	ROV of jacket and tube bundle return line ROV air failed safe position is air failed to open condition.
		Agitation	Decoupling	Runaway may possible	No load tripping available in case agitator decoupling.	Interlock to be provide to close CO2 supply line ROV & PCV in case of agitator decoupling.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**10% H2SO4 charging in quenching reactor (041RT-095)**				
1	Quantity/Flow	No/Less	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available on reactor with high and high high alarm.	1. Vent line valve should be locked open.
		High/More	Human error (Wrong input in Totaliser/Flow meter)	1. Exotherm may possible in the reactor and fumes may space through vent line of reactor. 2. Overflow from reactor may lead to spillage hazard	1. TI is available in the reactor with high and high high alarms. 2. Chilling & cooling utility supply provision is available to control temperature. 3.Flow meter with CV is available in H2SO4 addition line. 4.PT is	1.Flash alarm to be provided at HH temperature of reactor TI. 2. Upper limit of the flow meter & totaliser to be freezed. 3.Flash alarm to be provided at HH value of reactor PT. 4.Interlock to be provide to close the addition line CV at HH value of PT & TI of the reactor.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					available in reactor with high and high alarm.	
2	Pressure	High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the addition line CV at HH value of PT of the reactor.
3	Temperature	High	Human Error (Manual valve of utility supply & return not opened)	Exotherm may possible in the reactor	1. Trained manpower and SOP is available to line up chilling water before solvent charging. 2. TI is available in the reactor and utility return & supply line with high and high high alarms. 3.TI is available in reactor with high and high high alarms.	1.Flash alarm to be provide at HH temperature of reactor TI. 2. Interlock to be provide to close H2SO4 addition CV at HH value of TI in reactor. 3. Upper limit of the flow meter & totaliser to be freezed.
			Fast addition of H2SO4 in reactor		Flowmeter & totaliser is available in the addition line.	Upper limit of the flow meter & totaliser to be freezed.
			Human error(Manual valve of steam supply line open/passed)		1.Trained manpower is deputed for operation and ensure proper-line up before startup.	1.steam line to be blinded before start up to avoid human error.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
4	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	H2SO4 addition line CV air failed safe position is air failed to closed condition.
		Agitation	Agitator decoupled due to mechanical failure	Exotherm may possible	1.No load tripping is available.	Interlock to be provide to close addition line CV at tripping/stop of agitator.
Stream-2		**Toluene charging in quenching reactor (041RT-095)**				
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise can lead to fire/health hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up. 4.Fire extinguisher and fire hydrant point is available in near by area. 5.All electrical installation are flameproof as per HAC classification	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Line leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					per HAC classification.	
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the toluene charging line ROV & transferring pump at HH value of PT of the reactor. 3.Flash alarm to be provide on HH value of PT of the reactor.
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Flow meter with totaliser is available in toluene charging line. 2.Trained manpower is deputed for DCS operation.	Upper limit of the flow meter & totaliser to be freezed.
2	Pressure	High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	1. Vent line valve should be locked open. 2.Interlock to be provide to close the toluene charging line ROV & transferring pump at HH value of PT of the reactor. 3.Flash alarm to be provide on HH value of PT of the reactor.
3	Others	Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running	1.Toluene charging line ROV air failed safe position is air failed to closed condition.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					indication on DCS is available.	
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	Interlock to be provide to stop toluene charging pump & close charging line ROV at tripping/stop of agitator.
Stream-3		**Organic material loading from quenching reactor to organic storage tank(040ST-158) & unloading of organic storage tank(040ST-158)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Recommend to provide overload tripping on pump.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1.Flame arrestor PM to be performed as per pre-defined schedule.
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Double mechanical seal to be provide in pump.
		High/More	LS malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	PM of critical instrument is performed before startup.	1.Spill kit to be provided in the nearby area to contain spillage. 2.PM of critical instrument to be performed as per predefined schedule.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Flame arrestor chocked (Storage tank vent line)		PM of flame arrestor is performed before startup.	1.Flame arrestor PM to be performed as per pre-defined schedule.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
			Flame arrestor chocked (Storage tank vent line)		PM of flame arrestor is performed before startup.	1.Flame arrestor PM to be performed as per pre-defined schedule.
3	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.
Stream-4		**Aqueous material loading from quenching reactor to aqueous storage tank(040ST-156) & unloading of aqueous storage tank(040ST-156)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					per HAC classification.	
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
		High/More	LS malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	PM of critical instrument is performed before startup.	Spill kit to be provided in the nearby area to contain spillage.
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	1. Vent line manual valve to be in critical locked open condition with LO tag.
3	Level	Low	Refer low Flow			
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.

Node 6		Node Description : Quenching reactor(041RT-095)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					near by area. 4.All electrical installation are flameproof as per HAC classification.	

Node 7		Node Description : Chlorination reactor(042RT-103)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**THF recovery from chlorination reactor(042RT-103)**				
1	Pressure	High	Human error (Vent line/vapour line valve not opened)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in reactor with high and high high alarm. 3.Reactor design pressure is up to 6 bar.	1. Vent line valve should be locked open. 2.Interlock to be provide to closed the steam TCV at HH value of PT of the reactor.
			Vent line flame arrestor chocked		PM is performed before start-up and record is maintained.	PM of flame arrestor is performed as per predefined schedule.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with	1.Flash alarm to be provide on HH value of PT of the reactor.

Node 7		Node Description : Chlorination reactor(042RT-103)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	
2	Temperature	High	Human error(TCV bypass line passed/open)	Reactor may pressurise & Exotherm may possible	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.TI is available in final vent line with high and high high alarm. 3.TI is provided inn reactor with high and high high alarm.	1.TCV bypass valve should be locked closed condition with tagging. 2. Flash alarm to be provided at HH temperature of the reactor. 3. Interlock to be provided to close steam line TCV at HH temperature of the reactor. 4. Interlock to be provided to close steam line TCV at HH temperature of the final vent line of TI.
3	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	TCV of steam line air failed safe position is air fail to close.
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping is provided.	Steam TCV to be closed in case of agitator stop/trip.
Stream-3		**Thionyl chloride addition from thionyl chloride day tank(043TK-246) in chlorination reactor(042RT-103)**				

Node 7		Node Description : Chlorination reactor(042RT-103)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
1	Quantity/Flow	No/Less	Line leakage	Spillage may lead to gas/liquid exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage.	1. Flange guard to be provided on all flanges. 2.Compatible gasket to be used.
			Flow meter malfunctioning/chocked	Process delay	.Flow meter PM to be performed before start the operation.	1.Flow meter PM to be performed as per predefined schedule.
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed addition line CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	1. Upper limit of the flow meter & totaliser to be freezed. 2. Flash alarm to be provided at HH temperature of reactor TI. 3. Interlock to be provided to closed addition CV at HH temperature of reactor.
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	1.Flow meter PM to be performed as per predefined schedule.

Node 7		Node Description : Chlorination reactor(042RT-103)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
2	Pressure	High	Human error (Scrubber line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the reactor. 4.Trained manpower is deputed for operation.	1. Recommended to provide interlock to closed addition CV at high high alarm of PT. 2. Recommended to provide interlock to closed addition CV at high high alarm of PT of the scrubber pot. 3. Flash alarm to be provider on HH value of PT of the reactor. 4.Recommend to provide interlock to closed the steam TCV at HH pressure of the reactor.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor.	1.Double valve to be provided in N2 supply line.
			Scrubber circulation pump trip/stop		Pump running indication is available on DCS	1.Thionyl chloride addition line CV to be closed in case of circulation pump trip/stop.

Node 7		Node Description : Chlorination reactor(042RT-103)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
3	Temperature	High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	1.PM of critical instruments to be performed ass per predefined schedule.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
			Fast addition rate		Flowmeter & totaliser is available in the addition line.	1.Upper limit of flowmeter and totaliser to be freeze. 2.Interlock to be provide that at HH temperature of reactor thionylchloride addition line CV to be stop. 3.Flash alarm to be provide on HH temperature of the reactor.

Node 7		Node Description : Chlorination reactor(042RT-103)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
4	Level	Low	Line leakage	Spillage and health hazard may possible	1. Line testing done before start-up. 2. Compatible gasket is used.	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all flanges.
5	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	Thionyl chloride addition line CV air failed safe position to be air failed to closed condition.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	Thionyl chloride addition line CV to be closed in case of agitator stop/trip.

Node 8		Node Description : Chlorination reactor(042RT-104)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**THF recovery from chlorination reactor(042RT-104)**				
1	Pressure	High	Human error (Vent line/vapour line valve not opened)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in reactor with high and high high alarm. 3.Reactor design pressure is up to 6 bar.	1. Vent line valve should be locked open. 2.Interlock to be provide to closed the steam TCV at HH value of PT of the reactor.
			vent line flame arrestor chocked		PM is performed before start-up and	PM of flame arrestor is performed as per predefined

Node 8		Node Description : Chlorination reactor(042RT-104)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					record is maintained.	schedule.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	1.Flash alarm to be provide on HH value of PT of the reactor.
2	Temperature	High	Human error(TCV bypass line passed/open)	Reactor may pressurise & Exotherm may possible	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.TI is available in final vent line with high and high high alarm. 3.TI is provided inn reactor with high and high high alarm.	1.TCV bypass valve should be locked closed condition with tagging. 2. Flash alarm to be provided at HH temperature of the reactor. 3. Interlock to be provided to close steam line TCV at HH temperature of the reactor. 4. Interlock to be provided to close steam line TCV at HH temperature of the final vent line of TI.

Node 8		Node Description : Chlorination reactor(042RT-104)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
3	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	TCV of steam line air failed safe position is air fail to close.
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping is provided.	Steam TCV to be closed in case of agitator stop/trip.
Stream-3		**Thionyl chloride addition from thionyl chloride day tank(043TK-246) in chlorination reactor(042RT-104)**				
1	Quantity/Flow	No/Less	Line leakage	Spillage may lead to gas/liquid exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage.	1. Flange guard to be provided on all flanges. 2.Compatible gasket to be used.
			Flow meter malfunctioning/chocked	Process delay	.Flow meter PM to be performed before start the operation.	1.Flow meter PM to be performed as per predefined schedule.
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed addition line CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to	1. Upper limit of the flow meter & totaliser to be freezed. 2. Flash alarm to be provided at HH temperature of reactor TI. 3. Interlock to be provided to closed addition CV at HH temperature of reactor.

Node 8		Node Description : Chlorination reactor(042RT-104)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					control temperature.	
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	1.Flow meter PM to be performed as per predefined schedule.
2	Pressure	High	Human error (Scrubber line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the reactor. 4.Trained manpower is deputed for operation.	1. Recommended to provide interlock to closed addition CV at high high alarm of PT. 2. Recommended to provide interlock to closed addition CV at high high alarm of PT of the scrubber pot. 3. Flash alarm to be provider on HH value of PT of the reactor. 4.Recommend to provide interlock to closed the steam TCV at HH pressure of the reactor.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.

Node 8		Node Description : Chlorination reactor(042RT-104)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor.	1.Double valve to be provided in N2 supply line.
			Scrubber circulation pump trip/stop		Pump running indication is available on DCS	1.Thionyl chloride addition line CV to be closed in case of circulation pump trip/stop.
3	Temperature	High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	1.PM of critical instruments to be performed ass per predefined schedule.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
			Fast addition rate		Flowmeter & totaliser is available in the addition line.	1.Upper limit of flowmeter and totaliser to be freeze. 2.Interlock to be provide that at HH

Node 8		Node Description : Chlorination reactor(042RT-104)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
						temperature of reactor thionyl chloride addition line CV to be stop. 3.Flash alarm to be provide on HH temperature of the reactor.
4	Level	Low	Line leakage	Spillage and health hazard may possible	1. Line testing done before start-up. 2. Compatible gasket is used.	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all flanges.
5	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	Thionyl chloride addition line CV air failed safe position to be air failed to closed condition.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	Thionyl chloride addition line CV to be closed in case of agitator stop/trip.

Node 9		Node Description : solvent recovery reactor(041RT-106)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Solvent recovery from solvent recovery reactor(041RT-106)**				
1	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
2	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before	1.PM of TCV is to be performed as per predefined schedule.

Node 9		Node Description : solvent recovery reactor(041RT-106)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					start operation.	
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
3	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.
4	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.
Stream-7		**Top Collection in receiver-500 LTR(043TK-250A) &(043TK-250B)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.

Node 9		Node Description : solvent recovery reactor(041RT-106)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Sample point/Drain point manual valve pass	Fire hazard due to spillage	1.All electrical installation are flameproof as per HAC classification. 2.Fire extinguisher and fire hydrant point is available near by area.	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
			No/low level in solvent recovery reactor	No HSE hazard/Process Delay	No existing safeguard.	1.Recommended to manually observe the level of reaction reactor during distillation at particular time interval .
			Loadcell malfunctioning	Overflow may possible from top collection receiver	1.Loadcell calibration is performed before startup. 2.No open vent in collection receiver.so, no chances of overflow.	1.PM of all critical instruments to be performed as per predefined schedule.
		High/More	Human error(Steam TCV more percentage open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.TI is available in distillation reactor with alarms.	1.At HH temperature of the solvent recovery reactor steam TCV to be closed.
2	Temperature	High	Utility failure in condenser	Temperature rise may possible in receiver	1.TI is available in receiver with high and high high alarms. 2.TI is available in utility supply and return line of condenser.	1.utility circulation pump indication to be provide on DCS. 2.Solvent recovery rector steam TCV to be closed in case of utility circulation pump stop/trip or high high temperature of utility supply line.
3	Level	Low	Receiver leakage	Fire hazard and health hazard due to spillage	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Loadcell is available in the collection receiver with low and low low alarms. 4.Thickness testing to be carried out as per PM schedule. 5.All electrical installation are flameproof as per	1. Spill kit to be provided in the nearby area to contain spillage.

Node 9		Node Description : solvent recovery reactor(041RT-106)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	

Node 10		Node Description : Crude MMBC storage reactor(042RT-105)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream -1		**Crude MMBC transfer to crude MMBC storage reactor(042RT-105)**				
1	Quantity/Flow	No/Less	Human error (Discharge manual valve not opened).	Transferring line may pressurise	1. Trained manpower will deputed for drum charging. 2.line design pressure is sustained to resist maximum discharge pressure of pump. 3. Fire extinguishers are available in nearby places.	1. Spill kit to be provided to contain spillage.
			Line/Flange leakage	Fire hazard/Spillage	1.Line leakage testing is done before start-up . 2.Compatible gasket is used. 3.All electrical installation are flameproof as per HAC classification. 4. Fire extinguishers are available in nearby places.	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all flanges.
			Human error(vent is not open in storage reactor)	Tank may pressurise	1.PT is available in the tank with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Tank design pressure is upto	1.Vent line valve should be locked open condition with tagging. 2.

Node 10		Node Description : Crude MMBC storage reactor(042RT-105)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					6 bar.	
			Vent line flame arrestor chocked		1.PM of flame arrestor is performed before startup. 2.Tank design pressure is upto 6 bar.	PM of flame arrestor to be performed as per predefined schedule.
2	Pressure	High	Human error (reactor vent line valve not opened)	Reactor may pressurise	1.PT is available in the reactor with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Tank design pressure is upto 6 bar.	1. Flash alarm to be provided on HH pressure of the tank. 2. Vent valve should be in critical locked open condition & tag to be provide on that.
			Vent line flame arrestor chocked		1.Material having no chocking property. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.Flame arrestor PM to be performed before start up.	1.Flame arrestor preventive maintenance to be performed as per predefined schedule.
			N2 manual valve passed/left open		1.Vent is provided on reactor and verified by supervisor that valve is always open during process. 2.PT is available in reactor with high and high high alarms. 3.Reactor design pressure is upto 6 bar.	1.Double manual valve to be provide in N2 purging line.

Node 10		Node Description : Crude MMBC storage reactor(042RT-105)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
3	Level	Low	Tank body leakage	Fire hazard/Spillage	1.Material is compatible with reactor MOC 2.Pressure testing is performed before startup. 3.Fire extinguishers are available in nearby places.	1.Spill kit to be provide to contain the spillage.'
			Tank bottom valve leakage/passed		Double manual valve to be provide at bottom of the day tank.	1.Spill kit to be provide to contain the spillage.'

Node 11		Node Description : Final distillation reactor(041RT-107)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Product distillation from final distillation reactor(041RT-107)**				
1	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.
2	Temperature	High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor.	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop &

Node 11		Node Description : Final distillation reactor(041RT-107)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	1.PM of TCV is to be performed as per predefined schedule.
			Human error(TCV bypass line passed/open)		No existing safeguard	1.TCV bypass valve should be locked closed condition with tagging.
3	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.
4	Others	Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.
		Agitation	Agitator decoupled due to mechanical	Runaway may possible	No existing safeguard	1.Agitator no load tripping to be provided. 2.Steam TCV to be

Node 11		Node Description : Final distillation reactor(041RT-107)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			failure			closed in case of agitator stop/trip.
Stream-2		**Top Collection in receiver-500 LTR(043TK-251A) &(043TK-251B)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard due to spillage	1.All electrical installation are flameproof as per HAC classification. 2.Fire extinguisher and fire hydrant point is available near by area.	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
			No/low level in solvent recovery reactor	No HSE hazard/Process Delay	No existing safeguard.	1.Recommended to manually observe the level of final distillation reactor during distillation at particular time interval .
			Loadcell malfunctioning	Overflow may possible from top collection receiver	1.Loadcell calibration is performed before startup. 2.No open vent in collection receiver.so, no chances of overflow.	1.PM of all critical instruments to be performed as per predefined schedule.
		High/More	Human error(Steam TCV more percentage open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.TI is available in distillation reactor with alarms.	1.At HH temperature of the solvent recovery reactor steam TCV to be closed.
2	Temperature	High	Utility failure in condenser	Temperature rise may possible in receiver	1.TI is available in receiver with high and high high alarms. 2.TI is available in utility supply and return line of	1.utility circulation pump indication to be provide on DCS. 2.Final distillation reactor steam TCV to be closed in case of utility circulation

Node 11		Node Description : Final distillation reactor(041RT-107)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					condenser.	pump stop/trip or high high temperature of utility supply line.
3	Level	Low	Receiver leakage	Fire hazard and health hazard due to spillage	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Loadcell is available in the collection receiver with low and low low alarms. 4.Thickness testing to be carried out as per PM schedule. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	1. Spill kit to be provided in the nearby area to contain spillage.

Node 12		Node Description : Pure MMBC storage tank(041ST-160)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Material loading and unloading in MMBC storage tank(041ST-160)**				
1	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.

Node 12		Node Description : Pure MMBC storage tank(041ST-160)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					area. 4.All electrical installation are flameproof as per HAC classification.	
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available in tank low and low low alarm. 2.PM is performed before startup.	1. Flash alarm to be provided on LL value of PT of the tank. 2. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.PM of critical instrument is performed before startup.	1.PM to be performed as per predefined schedule.
2	Pressure	Low	PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	1.PVRV PM to be performed as per pre-defined schedule.
		High	PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation.	1.PVRV PM to be performed as per pre-defined schedule.
			N2 line manual valve pass		1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank.	1.Double manual valve to be provide in N2 line. 2.Flash alarm to be provide on HH value of PT of the storage tank.
			N2 PRV failure		1.PT is available in tank high and high high alarm. 2.PVRV is	1.PM to be performed of PRV as per predefined schedule.

Node 12		Node Description : Pure MMBC storage tank(041ST-160)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					available in tank.	
3	Level	Low	Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	1.Thickness testing of tank to be performed as per predefined schedule.
			Tank bottom valve passed/leakage			1.Double manual valve to be provide at bottom of the tank.
4	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	Nitrogen inertisation to be performed in the tank.

Node 13		Node Description : HCl receiver for scrubber(040TK-252)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream -1		**Reaction in scrubber tank (040TK-252)**				
1	Quantity/Flow	No/Less	Scrubber circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS . 2.Vent line of scrubber column is given in secondary column.so,less chances of gas exposure.	1.Flash alarm to be provide on trip/stop of scrubber circulation pump. 2.Recommend to provide interlock to closed the thionyl addition line CV of chlorination reactor when scrubber circulation pump stop/trip. .

Node 13		Node Description : HCl receiver for scrubber(040TK-252)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup.
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Pump discharge valve should be critical locked open condition and tag to be provide on that.
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	No existing safeguard	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
		High/More	Graphite condenser leakage	Scrubber tank may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Scrubber tank vent is given in scrubber column.so,no chances of overflow.	1.Flash alarm to be provide on high high value of LI of scrubber tank. 2.Recommend to provide interlock to closed the thionyl addition line CV of chlorination reactor at HH value of LI of HCl receiver of scrubber tank.

Node 13		Node Description : HCl receiver for scrubber(040TK-252)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
2	Pressure	High	Vent line valve not opened (Human Error)	Scrubber tank may pressurise	1.PT is available on the tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of primary scrubber tank. 3.Recommend to provide interlock to closed the thionyl chloride addition line CV at HH pressure of HCL receiver of scrubber tank.
			Caustic scrubber reactor circulation pump stop/trip		1.Pump running indication is available o DCS.	
3	Temperature	High	Utility failure in jacket of the tank	Temperature rise may possible in scrubber tank	1.TI is available in HCl receiver with high and high high alarms. 2.TI is available in utility supply and return line of scrubber tank with alarms. 3.TI is available in utility return line of the absorber column.	1.Utility circulation pump indication to be provide on DCS.
			Utility failure in jacket of the absorber column			
4	Level	Low level in tank	Tank leakage	Gas/Liquid Exposure due to spillage	Receiver MOC is compatible so leakage is not possible	1.Spill kit to be provided in nearby area to contain spillage.
Stream -2		**Reaction in caustic scrubber tank (040RT-109)**				
1	Quantity/Flow	No/Less	Caustic Scrubber circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS .	1.Flash alarm to be provide on trip/stop of caustic scrubber circulation pump. 2.Recommend to provide interlock to closed the thionyl addition line CV of chlorination reactor when scrubber circulation pump stop/trip. .

Node 13		Node Description : HCl receiver for scrubber(040TK-252)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up.	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup.
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	1.Pump discharge valve should be critical locked open condition and tag to be provide on that.
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	No existing safeguard	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.
2	Pressure	High	Vent line valve not opened (Human Error)	Scrubber tank may pressurise	1.PT is available on the tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar.	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of caustic scrubber tank. 3.Recommend to provide interlock to closed the thionyl chloride addition line CV at HH pressure of caustic scrubber reactor.
3	Temperature	High	Utility failure in jacket of the tank	Temperature rise may possible in scrubber tank	1.TI is available in caustic scrubber reactor with	1.Utility circulation pump indication to be provide on DCS.

Node 13		Node Description : HCl receiver for scrubber(040TK-252)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					high and high high alarms. 2.TI is available in utility supply and return line of scrubber reactor with alarms.	
4	Level	Low	Tank leakage	Gas/Liquid Exposure due to spillage	Receiver MOC is compatible so leakage is not possible	1.Spill kit to be provided in nearby area to contain spillage.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		Title : HAZOP Study Of MMBC project at 8203 site							Plant Name: Plant 04, Date-11/12/2023			
Node 1		Node Description : MCT storage tank (040ST-145)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Material loading and unloading in MCT storage tank										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.Flow meter is available in material transferring line . 3.LI is available in storage tank to monitor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 1		**Node Description : MCT storage tank (040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 1		**Node Description : MCT storage tank (040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double mechanical seal to be provide in pump.	2	3	6
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	3	3	9	1. Recommended to provide interlock to stop transferring pump at HH alarm value of LI & LS activation of storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH alarm value of LI of storage tank. 4.Flash alarm to be provided on LS activation of storage tank.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 1		**Node Description : MCT storage tank (040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									LL alarm value of PT of the storage tank.			
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 1		**Node Description : MCT storage tank (040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
			N2 line manual valve pass		1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Double manual valve to be provide in N2 line.	2	4	8
			N2 PRV failure		1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 1		**Node Description : MCT storage tank (040ST-145)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	Wrong material supplied from vendor	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before tanker unloading start.	2	3	6				
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 2		**Node Description : THF storage tank (040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Material loading and unloading in THF storage tank**										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS. 2.Flow meter is available in material transferring line . 3.LI is available in storage tank to monitor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 2		**Node Description : THF storage tank (040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double mechanical seal to be provide in pump.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 2		**Node Description : THF storage tank (040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	More capacity of tanker is arrived than storage reactor capacity	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.LI is provided with alarms on storage tank to monitor level during unloading. 2.Before start tanker unloading verified tanker weight or volume by plant/tankfarm person. 3.Storage tank capacity is much greater than tanker capacity so, overflow is not possible. 4.LS is also available in storage tank.	3	3	9	1. Recommended to provide interlock to stop transferring pump at HH alarm value of LI & LS activation of storage tank. 2.Spill kit to be provided in the nearby area to contain spillage. 3.Flash alarm to be provided on HH alarm value of LI of storage tank. 4.Flash alarm to be provided on LS activation of storage tank.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on LL value of PT o the tank. 3. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 2		**Node Description : THF storage tank (040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank low and low low alarm. 3.PVRV is available in tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 1.PM is carried out before start operation.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank with high and high high alarm. 3. ESH is provided in the tank. 4.PVRV is available on tank.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of the storage tank. 3. Interlock to be provided to stop tank loading pump at HH alarm value of PT of the storage tank.	2	4	8
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			PVRV chocked/malfunctioning		1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation. 3.ESH is available on tank.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 2		**Node Description : THF storage tank (040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass		1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank. 4.ESH is available on tank.	3	4	12	1.Double manual valve to be provide in N2 line.	2	4	8
			N2 PRV failure		1.PT is available in tank high and high high alarm. 2.PVRV is available in tank. 3.ESH is available on tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									
5	Composition	Other than	Wrong material supplied from vendor	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before tanker unloading start.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 2		**Node Description : THF storage tank (040ST-179)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity		Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**MCT charging in grignard addition reactor (043RT-083)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	2	6				
			MCT Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the MCT transferring line ROV at HH value of PT of the reactor.and after 20 sec MCT transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Upper limit of the totalizer to be freeze.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6bar.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the MCT transferring line ROV at HH value of PT of the reactor.and after 20 sec MCT transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Reactor Bottom valve left open/pass	Health & fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.MCT charging line ROV air failed safe position is air failed to closed condition.			
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream-2		**THF charging in grignard addition reactor (043RT-083)**										
7	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	2	6				
			THF Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.			
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12	PM of flame arrestor to be performed as per predefined schedule.	2	4	8
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Upper limit of the totalizer to be freeze.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6bar.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12	PM of flame arrestor to be performed as per predefined schedule.	2	4	8
9	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
10	Level	Low	Reactor Bottom valve left open/pass	Health & fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.THF charging line ROV air failed safe position is air failed to closed condition.			
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream-3		**Mixing in grignard addition reactor (043RT-083)**										
13	Quantity/Flow	No/Less	Refer low flow of stream 1&2	-	-				-			
		High/More	Refer high flow of Stream 1&2	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
14	Pressure	Low	No probable cause	-	-				-			

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	N2 line manual valve pass/Left open due to human error	Reactor may pressurise	1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2.	3	4	12	1.Double valve to be provided in N2 supply line.	2	4	8
			Human error(Manual vent line valve is not open)		1.Trained manpower will operate the operation. and ensure valve position before start operation. 2.PT is available with high and high high alarm in reactor.	3	4	12	1. Vent line valve should be locked open. 2.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
			Vent line flame arrestor chocked		1.Flame arrestor PM is performed as per PM schedule.	3	4	12	PM of flame arrestor to be performed as per predefined schedule.	2	4	8
15	Temperature	Low	Human error(cooling water supply valve open)	No HSE hazard/Process Delay	1.Trained manpower will operate the operation.	3	1	3				
		High	Human error(Steam supply line valve open)	Temperature rise may possible in reactor	1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12	1.Steam line to be blinded to avoid human error.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
16	Level	Low	Line/Flange leakage	Fire hazard and health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used. 5. LI is available in the reactor.	3	3	9	1.Spill kit to be provide to contain spillage. 2.Line design pressure need to be confirmed before startup. 3.Compatible gasket to be used prevent gasket leakage.	2	3	6
			Reactor bottom valve passed/leakage		1.Compatible MOC of valve is used at bottom of the reactor.	3	3	9	1.Double manual valve to be provided at bottom of the reactor.	2	3	6
			Reactor Leakage		Reactor MOC is compatible with material.	3	3	9	1.Reactor thickness testing to be done on quarterly basis as per PM schedule.	2	3	6
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.MOC is compatible with material. 2.PG is available in utility return line. 3.No incompatible hazard with reaction mass& utility in case of jacket puncture.	3	3	9				
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	No probable cause	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 3		**Node Description : Grignard addition reaction reactor(043RT-083)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	No load tripping is provided on agitator.	3	2	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Mg turnings charging into grignard reactor(042RT-086)**										
1	Quantity/Flow	No/Less	Human Error(Less Quantity charged)	No HSE hazard	Fixed quantity of material will be issued from the store batchwise.	2	2	4				
			Wrong measured quantity supplied from store department	No HSE hazard	Issue slip & physical verification of quantity is done before start-up.	2	2	4				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Spillage)	No HSE hazard	1. Full body air supply suit is wear by person during charging. 2. Trained manpower will be deputed for this activity. 3. Hopper with valve will be used for charging.	3	1	3	1. Spill kit to be provided to contain spillage. 2. Area barrication to be done to restrict man movement during charging.	2	1	2
		High/More	Human Error(More Quantity charged) Wrong measured quantity supplied from store department	No HSE hazard	1. Fixed quantity of material will be issued from the store batchwise. 2. Issue slip & physical verification of quantity is done before start-up. 3. Trained manpower will performed the activity.	3	1	3				
		Mis-directed flow	No probable cause									
2	Pressure	Low	Not Applicable									
		High	Not Applicable									
3	Temperature	Low	Not Applicable									
		High	Not Applicable									
4	Level	Low	Not Applicable									
		High	Not Applicable									
5	Composition	Other than	Not Applicable									
6	Other	Static Electricity	Not Applicable									
		Instrument Air	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		failure										
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
		Leakage spillage	-	No HSE hazard								
Stream-2		**(THF+MCT) addition in grignard reactor(042RT-086) from grignard addition reactor(043RT-083)**										
7	Quantity/Flow	No/Less	Human error (Bottom manual valve of reactor not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in addition line	3	3	9				
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3.Fire extinguisher and fire hydrant point is provided in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1. Flange guard to be provided on all flanges. 2.Compatible gasket to be used.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Vent line valve not opened)	Reactor may implode	1. SOP is available to open vent valve before starting transferring activity. 2. compound PT is available in the grignard addition reactor with low and low low alarms.	3	4	12	1. Vent line valve should be critical locked open condition with tag.	2	4	8
			Low level in grignard addition reactor	No HSE hazard	Flow meter is available in addition line .	3	1	3				
			Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation. 2.Material having no chocking property.	3	2	6	1.Flow meter PM to be performed as per predefined schedule.	2	2	4
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	3	4	12	1. Upper limit of the flow meter & totaliser to be freezed. 2. Flash alarm to be provided at HH temperature of reactor TI. 3. Interlock to be provided to closed addition CV at HH temperature of reactor.	2	4	8
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12	1.Flow meter PM to be performed as per predefined schedule.	2	4	8
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
8	Pressure	Low	No probable cause									
		High	Human error (Vent line/vapour line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3.RD is available on reactor for overpressure protection.	3	4	12	1. Recommended to provide interlock to closed addition CV at high high alarm of PT of the reactor. 2. Vent line valve should be critical locked open with tag. 3.Recommend to provide interlock to closed the steam TCV at HH pressure of the reactor. 4.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
			Human error (Vent line of catch pot not open)		1.PT is available in catch pot with high and high high alarm. 2.RD is available on reactor for overpressure protection.	3	4	12	1.Flash alarm to be provide on HH value of PT of the catch pot. 2. Recommended to provide interlock to closed addition CV at high high alarm of PT of the catch pot.	2	4	8
			Flame arrestor chocked		PM of flame arrestor is performed before startup.	3	4	12	PM of flame arrestor to be done as per predefined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition.	3	4	12	1.Double valve to be provided in N2 supply line.	2	4	8
			THF + MCT addition rate fast		Refer high flow safeguard	3	4	12				
9	Temperature	Low	Cooling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12	1.PM of critical instruments to be performed ass per predefined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the reactor with high and high high alarms. 1.Trained manpower is deputed for DCS operation.	3	4	12	1.Recommend to provide interlock to closed the steam TCV at HH value of TI of reactor.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			Fast addition rate of THF+MCT		Flowmeter & totaliser is available in the addition line.	3	4	12	1.Upper limit of flowmeter and totaliser to be freeze. 2.Interlock to be provide that at HH temperature of reactor THF+MCT line addition CV to be stop. 3.Flash alarm to be provide on HH temperature of the reactor.	2	4	8
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all flanges.	2	3	6
			Reactor body leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the hopper. 2. Earthing strip is provided on the flanges. 3.N2 inertisation to be perform during charging.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.THF + MCT addition line CV air failed safe position to be air failed to closed condition.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-2/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 4		**Node Description : Grignard reactor(042RT-086)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	3	4	12	1.Steam TCV to be closed in case of agitator stop/trip. 2.THF+MCT addition line CV to be closed in case of agitator stop/trip.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**THF charging in Coupling reactor(042RT-089)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	3	2	6				
			THF Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12	PM of flame arrestor to be performed as per predefined schedule.	2	4	8
		High/More	Human error (Wrong input in totaliser)	Reactor may overflow and chances of fire &spillage hazard	1.Trained manpower is deputed for DCS operation. 2.Fire extinguisher and fire hydrant point is available in near by area. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Upper limit of the totalizer to be freeze.	2	3	6
		Reverse	No probable cause									
		Mis-	Manual valve	No HSE hazard	1. Double manual valve is	2	2	4				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		directed flow	pass		available.							
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1.PT is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation and ensure proper line up before startup. 3.Reactor design pressure is up to 6bar.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the THF transferring line ROV at HH value of PT of the reactor.and after 20 sec THF transferring pump to be stop. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
			Vent line flame arrestor chocked		Flame arrestor PM is performed as per PM schedule.	3	4	12	PM of flame arrestor to be performed as per predefined schedule.	2	4	8
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left open/pass	Health & fire hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Reactor body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.THF charging line ROV air failed safe position is air failed to closed condition.	3	1	3
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3				
Stream -2		**AECAT-703 charging through hopper in coupling reactor(042RT-089)**										
7	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard/Process Delay	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3	-			

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human Error (More quantity charged)	No HSE hazard	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	No probable cause									
		High	No probable cause									
11	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	-	Two numbers of DG is available for power backup.	3	1	3	-			
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3	-			
		Agitation	-	No HSE hazard								
Stream-3		**CO2 addition in coupling reactor(042RT-089)**										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of CO2 PRS not opened). Human error (manual valve of CO2 receiving line on CO2 coupling reactor not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	2	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage	leakage may lead to gas exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage. 3. Flange guard is provided on all flanges. 4.Compatible gasket issued. 5.All electrical installation as per HAC classification.	3	3	9				
			Low pressure in CO2 cryo system	No HSE hazard/Process Delay	1.Flow meter is available in addition line. 2.PT is available in CO2 addition line .	3	2	6				
			Flow meter malfunctioning/chocked	Process delay	1.Flow meter PM to be performed before start the operation.	3	2	6	2.Flow meter PM is performed as per predefined schedule.	2	2	4
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed CO2 addition line ROV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Brine supply provision is available in jacket of the reactor to control temperature. 5. Interlock is provided to closed addition ROV at HH temperature of reactor.	3	4	12	1.Flash alarm to be provide at HH temperature of reactor TI. 2. Upper limit of the flow meter & totaliser to be freezed as per process requirement.	2	4	8
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
		Reverse	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	CO2 supply pressure high	Reactor may pressurize	1. CO2 PRS system available to supply required pressure. 2. PCV available to supply CO2 pressure in coupling reactor. 3. ROV is available in the CO2 supply line. 4. PT is available in reactor with high and high high alarm. 5. Interlock is available to close ROV and PCV in case of high high pressure of reactor. 6. PT is available in the CO2 supply line with high and high high alarms. 7. Interlock is also available to close ROV and PCV of CO2 supply line on high high value of CO2 supply line PT.	3	4	12	1.Flash alarm to be provide on high high value of PT of coupling reactor. 2.Flash alarm to be provide on high high value of PT of CO2 supply line of coupling reactor.	2	4	8
15	Temperature	Low	No probable cause	No HSE hazard.								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	CO2 supply pressure high	Exotherm may possible in reactor	1. TI is available in the reactor with high and high high alarms. 2. Interlock is available to close ROV & PCV of CO2 supply line on high high value of TI of the reactor. 3. ROV & PCV is available in the CO2 supply line. 4. For high supply pressure safeguards, refer high pressure scenario. 5. Interlock is available to open the brine supply line ROV of jacket of the reactor at HH value of TI of the reactor. 6.Interlock is available to open the brine return line ROV of tube bundle at HI value of TI of reactor.	3	4	12	1.Flash alarm to be provided on HH value of TI of the reactor.	2	4	8
			Human error(Manual valve of steam supply line left open/passed)	Exotherm may possible in reactor	1.Trained manpower is deputed for operation and ensure proper line up before startup.	3	4	12	1.Steam line to be blinded to avoid human error.	2	4	8
16	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	3	3	9				
			Reactor body leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer low Flow	Reactor may								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 5		**Node Description : Coupling reactor(042RT-089)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Jacket puncture of the reactor	overflow and chances of spillage/leakage	Before startup spark test & thickness testing is performed.	3	3	9				
			Tube bundle leakage in reactor		PM of tube bundle is performed before startup.	3	3	9				
17	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the hopper. 2. Earthing strip is provided on the flanges. 3. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.CO2 addition line ROV & PCV air failed safe position is air failed to closed condition. 2. Brine supply line ROV of jacket and tube bundle return line ROV air failed safe position is air failed to open condition.	3	1	3
		Power failure	GEB power failure	Runaway may possible	DG backup is provided to all critical Equipments.	3	3	9				
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Decoupling	Runaway may possible	No load tripping available in case agitator decoupling.	4	3	12	Interlock to be provide to close CO2 supply line ROV & PCV in case of agitator	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			Title : HAZOP Study Of MMBC project at 8203 site						Plant Name: Plant 04, Date-11/12/2023			
Node 5		Node Description : Coupling reactor(042RT-089)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
									decoupling.			

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			Title : HAZOP Study Of MMBC project at 8203 site						Plant Name: Plant 04, Date-11/12/2023			
Node 6		Node Description : Quenching reactor(041RT-095)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		10% H2SO4 charging in quenching reactor (041RT-095)										
1	Quantity/Flow	No/Less	Human error(10%H2SO4 receiving line valve not open) Human error (Discharge manual valve not opened).	Process delay No HSE hazard	1.Trained manpower is deputed for operation and ensure proper-line up before startup. 2.Flow meter is available in addition line.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage	Health hazard due to spillage	1.Line pressure testing is done before start-up. 2.Compatible gasket is used. 3.Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available on reactor with high and high high alarm.	3	4	12	1. Vent line valve should be locked open.	2	4	8
			Low level in 15%H2SO4 tank	No HSE hazard	1.Flow meter is available in transferring line. 2.LI is available in H2SO4 storage tank with low and low low alarm.	3	2	6				
			Flow meter malfunction	Process delay	Flowmeter PM is performed before start-up.	3	2	6				
		High/ More	Human error (Wrong input in Totaliser/Flow meter)	1. Exotherm may possible in the reactor and fumes may space through vent line of reactor. 2. Overflow from reactor may lead to spillage hazard	1. TI is available in the reactor with high and high high alarms. 2. Chilling & cooling utility supply provision is available to control temperature. 3.Flow meter with CV is available in H2SO4 addition line. 4.PT is available in reactor with high and high alarm.	3	4	12	1.Flash alarm to be provided at HH temperature of reactor TI. 2. Upper limit of the flow meter & totaliser to be freezed. 3.Flash alarm to be provided at HH value of reactor PT. 4.Interlock to be provide to close the addition line CV at HH value of PT &	3	3	9

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									TI of the reactor.			
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the addition line CV at HH value of PT of the reactor.	2	4	8
3	Temperature	Low	No probable cause									
		High	Human Error (Manual valve of utility supply & return not opened)	Exotherm may possible in the reactor	1. Trained manpower and SOP is available to line up chilling water before solvent charging. 2. TI is available in the reactor and utility return & supply line with high and high high alarms. 3.TI is available in reactor with high and high high alarms.	3	4	12	1.Flash alarm to be provide at HH temperature of reactor TI. 2. Interlock to be provide to close H2SO4 addition CV at HH value of TI in reactor. 3. Upper limit of the flow meter & totaliser to be freezed.	2	4	8
			TI malfunction		TI is available in the utility supply & return line with high and high high alarms.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Fast addition of H2SO4 in reactor		Flowmeter & totaliser is available in the addition line.	3	4	12	Upper limit of the flow meter & totaliser to be freezed.	2	4	8
			Human error(Manual valve of steam supply line open/passed)		1.Trained manpower is deputed for operation and ensure proper-line up before startup.	3	4	12	1.steam line to be blinded before start up to avoid human error.	2	4	8
4	Level	Low	Reactor Bottom valve left open/pass	Health hazard due to spillage	Trained manpower and SOP is available before line up.	2	4	8				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges.	2	4	8				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	4	8				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
5	Composition	Other than	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	H2SO4 addition line CV air failed safe position is air failed to closed condition.	3	1	3
		Power Failure	GEB power failure	No HSE hazard								
			DG failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	Exotherm may possible	1.No load tripping is available.	3	4	12	Interlock to be provide to close addition line CV at tripping/stop of agitator.	2	4	8
Stream-2		**Toluene charging in quenching reactor (041RT-095)**										
7	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise can lead to fire/health hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up. 4.Fire extinguisher and fire hydrant point is available in near by area. 5.All electrical installation are flameproof as per HAC classification	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Toluene Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	3	2	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			No level in toluene storage tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available in tank with low and low low alarm.	3	1	3				
			Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the toluene charging line ROV & transferring pump at HH value of PT of the reactor. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
		High/ More	Human error (Wrong input in totaliser)	No HSE hazard	1.Flow meter with totaliser is available in toluene charging line. 2.Trained manpower is deputed for DCS operation.	3	2	6	Upper limit of the flow meter & totaliser to be freezed.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					reverse flow.							
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in the reactor . 3.PT is available in reactor with high and high alarm. 4.Reactor design pressure is up to 6 kg/cm2.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to close the toluene charging line ROV & transferring pump at HH value of PT of the reactor. 3.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8
9	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
10	Level	Low	Reactor Bottom valve left open/pass	Health hazard & fire hazard due to spillage	Trained manpower and SOP is available before line up. 2.Double manual valve is available at bottom of the reactor.	2	3	6				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used. 3. Spill kit to be provided at nearby area to contain the spillage. 4. Flange guard to be provided on all flanges. 5.Fire extinguisher and fire hydrant point is available in near by area. 6.All electrical installation are flameproof as per HAC classification.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Toluene charging line ROV air failed safe position is air failed to closed condition.			
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay	1.No load tripping is provided on agitator.	3	1	3	Interlock to be provide to stop toluene charging pump & close charging line ROV at tripping/stop of agitator.	3	1	3
Stream-3		**Organic material loading from quenching reactor to organic storage tank(040ST-158) & unloading of organic storage tank(040ST-158)**										
13	Quantity/Flow	No/Less	Unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump indication is provided on DCS.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Recommend to provide overload tripping on pump.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Flame arrestor chocked (Storage tank vent line)		1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
			Pump seal leakage	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Double mechanical seal to be provide in pump.	2	4	8
		High/ More	LS malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	PM of critical instrument is performed before startup.	3	3	9	1.Spill kit to be provided in the nearby area to contain spillage. 2.PM of critical instrument to be performed as per predefined schedule.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	Wrong line up(Manual valve or pump start of aqueous tank instead of organic tank line up)	No HSE hazard/Process Delay	-				-			
14	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Flame arrestor chocked (Storage tank vent line)		PM of flame arrestor is performed before startup.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
			Flame arrestor chocked (Storage tank vent line)		PM of flame arrestor is performed before startup.	3	4	12	1.Flame arrestor PM to be performed as per pre-defined schedule.	2	4	8
15	Temperature	Low	No credible cause									
		High	No credible cause									
16	Level	Low	Refer low									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									
17	Composition	Other than										
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6				
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Aqueous material loading from quenching reactor to aqueous storage tank(040ST-156) & unloading of aqueous storage tank(040ST-156)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
19	Quantity/Flow	No/Less	Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6
			Human Error (Discharge Valve not opened)	No HSE hazard	1.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	1	3				
			Sample point/Drain point manual valve pass	Health and fire hazard due to spillage	1.Fire extinguisher and fire hydrant point is available in near by area. 2.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			Human error (Storage tank vent valve is not open)	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
		High/ More	LS malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	PM of critical instrument is performed before startup.	3	3	9	Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	Wrong line up(Manual valve or pump start of organic tank instead of aqueous tank line up)	No HSE hazard					-			
20	Pressure	Low	Human error (Storage tank vent valve is not open) during unloading	Tank may implode	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
		High	Vent line valve not opened (Human Error) during loading	Tank may pressurise	1. Trained manpower will perform unloading activity and ensure valve operation before start-up.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8
21	Temperature	Low	No credible cause									
		High	No credible cause									
22	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-3/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 6		**Node Description : Quenching reactor(041RT-095)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					classification.							
		High	Refer high Flow									
23	Composition	Other than										
24	Others	Static Electricity	-									
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project			
P &ID number : 8203/MMBC-STAGE-4/001	**Title : HAZOP Study Of MMBC project at 8203 site**		**Plant Name: Plant 04, Date-11/12/2023**
Node 7	**Node Description : Chlorination reactor(042RT-103)**		

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		**THF recovery from chlorination reactor(042RT-103)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line/vapour line valve not opened)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in reactor with high and high high alarm. 3.Reactor design pressure is up to 6 bar.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to closed the steam TCV at HH value of PT of the reactor.	2	4	8
			Vent line flame arrestor chocked		PM is performed before start-up and record is maintained.	3	4	12	PM of flame arrestor is performed as per predefined schedule.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12	1.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passes)	No HSE hazard	1.Trained manpower is deputed for operation and ensure valve is open before startup.							
		High	TCV failure/stuck open	Reactor may pressurise & Exotherm may possible	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PM of TCV is performed before start operation. 5.TI is provided inn reactor with high and high high alarm.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.TI is available in final vent line with high and high high alarm. 3.TI is provided inn reactor with high and high high alarm.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging. 2. Flash alarm to be provided at HH temperature of the reactor. 3. Interlock to be provided to close steam line TCV at HH temperature of the reactor. 4. Interlock to be provided to close steam line TCV at HH temperature of the final vent line of TI.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up. 4.Tantalum plug is provided inn the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9	TCV of steam line air failed safe position is air fail to close.	2	3	6
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping is provided.	3	3	9	Steam TCV to be closed in case of agitator stop/trip.	2	3	6
Stream -2		**Dimethyl formate charging through hopper in chlorination reactor(042RT-103)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard/Process Delay	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3	-			
		High/More	Human Error (More quantity charged)	No HSE hazard	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	No probable cause									
		High	No probable cause									
11	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	-	Two numbers of DG is available for power backup.	3	1	3	-			
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3	-			
		Agitation	-	No HSE hazard								
Stream-3		**Thionyl chloride addition from thionyl chloride day tank(043TK-246) in chlorination reactor(042RT-103)**										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of day tank not opened). Human error (manual valve of thionyl chloride receiving line of	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line . 3.Loadcell is available in thionyl chloride day tank.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			chlorination reactor not opened).									
			Line leakage	Spillage may lead to gas/liquid exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage.	3	3	9	1. Flange guard to be provided on all flanges. 2.Compatible gasket to be used.	2	3	6
			Human error (Vent line valve not opened)	Day tank of may implode	1. SOP is available to open vent valve before starting transferring activity. 2.Day tank is design for full vacuum.	3	4	12				
			Low level in (043TK-246) thionyl chloride day tank	No HSE hazard	1.Flow meter is available in addition line 2.Loadcell is available in day tank .	3	1	3				
			Flow meter malfunctioning/chocked	Process delay	.Flow meter PM to be performed before start the operation.	3	2	6	1.Flow meter PM to be performed as per predefined schedule.	2	2	4
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed addition line CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	3	4	12	1. Upper limit of the flow meter & totaliser to be freezed. 2. Flash alarm to be provided at HH temperature of reactor TI. 3. Interlock to be provided to closed addition CV at HH temperature of reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12	1.Flow meter PM to be performed as per predefined schedule.	2	4	8
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Scrubber line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the reactor. 4.Trained manpower is deputed for operation.	3	4	12	1. Recommended to provide interlock to closed addition CV at high high alarm of PT. 2. Recommended to provide interlock to closed addition CV at high high alarm of PT of the scrubber pot. 3. Flash alarm to be provider on HH value of PT of the reactor. 4.Recommend to provide interlock to closed the steam TCV at HH pressure of the reactor.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					with high and high high alarm.							
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor.	3	4	12	1.Double valve to be provided in N2 supply line.	2	4	8
			Thionyl chloride addition rate fast		Refer high flow safeguard	3	4	12				
			Scrubber circulation pump trip/stop		Pump running indication is available on DCS	3	4	12	1.Thionyl chloride addition line CV to be closed in case of circulation pump trip/stop.			
			Venturi chocked		Material having no chocking property.	3	4	12				
15	Temperature	Low	Cooling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12	1.PM of critical instruments to be performed ass per predefined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			Fast addition rate		Flowmeter & totaliser is available in the addition line.	3	4	12	1.Upper limit of flowmeter and totaliser to be freeze. 2.Interlock to be provide that at HH temperature of reactor thionylchloride addition line CV to be stop. 3.Flash alarm to be provide on HH temperature of the reactor.	2	4	8
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				
16	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 7		**Node Description : Chlorination reactor(042RT-103)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									provided on all flanges.			
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9	Thionyl chloride addition line CV air failed safe position to be air failed to closed condition.	2	3	6
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	3	3	9	Thionyl chloride addition line CV to be closed in case of agitator stop/trip.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**THF recovery from chlorination reactor(042RT-104)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (Vent line/vapour line valve not opened)	Reactor may pressurise	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in reactor with high and high high alarm. 3.Reactor design pressure is up to 6 bar.	3	4	12	1. Vent line valve should be locked open. 2.Interlock to be provide to closed the steam TCV at HH value of PT of the reactor.	2	4	8
			vent line flame arrestor chocked		PM is performed before start-up and record is maintained.	3	4	12	PM of flame arrestor is performed as per predefined schedule.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in reactor & ensure before startup that valve is open condition. 5.PT is available in reactor with high and high high alarm.	3	4	12	1.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor. 2.Vent is provided in reactor & ensure before startup that valve is open condition. 3.Reactor design pressure is 6 bar. 4.N2 line maximum pressure is 3 kg/cm2. 5.Double valve is provided in N2 supply line	3	4	12				
3	Temperature	Low	Human error(cooling water supply line valve open/passes)	No HSE hazard	1.Trained manpower is deputed for operation and ensure valve is open before startup.							
		High	TCV failure/stuck open	Reactor may pressurise & Exotherm may possible	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PM of TCV is performed before start operation. 5.TI is provided inn reactor with high and high high alarm.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.TI is available in final vent line with high and high high alarm. 3.TI is provided inn reactor with high and high high alarm.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging. 2. Flash alarm to be provided at HH temperature of the reactor. 3. Interlock to be provided to close steam line TCV at HH temperature of the reactor. 4. Interlock to be provided to close steam line TCV at HH temperature of the final vent line of TI.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit to be provided in the nearby area to contain spillage.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.Earthing continuity is verified before start up. 4.Tantalum plug is provided inn the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9	TCV of steam line air failed safe position is air fail to close.	2	3	6
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may possible	1.Agitator no load tripping is provided.	3	3	9	Steam TCV to be closed in case of agitator stop/trip.	2	3	6
Stream -2		**Dimethyl formate charging through hopper in chlorination reactor(042RT-104)**										

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	Low/Less	Human Error (Less quantity charged)	No HSE hazard/Process Delay	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3	-			
		High/More	Human Error (More quantity charged)	No HSE hazard	1.Trained manpower will operate and predefined quantity will be feed to the hopper.	3	1	3				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	No probable cause									
		High	No probable cause									
11	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may possible	1. Issue slip & physical verification of material is done before start-up. 2. Sample testing is performed before material charging.	3	4	12				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
12	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	-	Two numbers of DG is available for power backup.	3	1	3	-			
		DCS Failure	Battery bank failure	-	Battery bank backup is provided and PM is done for the same periodically.	3	1	3	-			
		Agitation	-	No HSE hazard								
Stream-3		**Thionyl chloride addition from thionyl chloride day tank(043TK-246) in chlorination reactor(042RT-104)**										
13	Quantity/Flow	No/Less	Human error (Bottom manual valve of day tank not opened). Human error (manual valve of thionyl chloride receiving line of chlorination reactor not	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line . 3.Loadcell is available in thionyl chloride day tank.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			opened).									
			Line leakage	Spillage may lead to gas/liquid exposure	1.Line pressure testing is done before start-up. 2.Spill kit to be provided at nearby area to contain the spillage.	3	3	9	1. Flange guard to be provided on all flanges. 2.Compatible gasket to be used.	2	3	6
			Human error (Vent line valve not opened)	Day tank of may implode	1. SOP is available to open vent valve before starting transferring activity. 2.Day tank is design for full vacuum.	3	4	12				
			Low level in (043TK-246) thionyl chloride day tank	No HSE hazard	1.Flow meter is available in addition line 2.Loadcell is available in day tank .	3	1	3				
			Flow meter malfunctioning /chocked	Process delay	.Flow meter PM to be performed before start the operation.	3	2	6	1.Flow meter PM to be performed as per predefined schedule.	2	2	4
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 2. Interlock is available to closed addition line CV at set value of totaliser. 3. TI is available in the reactor with high and high high alarms. 4. Cooling water supply provision is available in jacket of the reactor to control temperature.	3	4	12	1. Upper limit of the flow meter & totaliser to be freezed. 2. Flash alarm to be provided at HH temperature of reactor TI. 3. Interlock to be provided to closed addition CV at HH temperature of reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12	1.Flow meter PM to be performed as per predefined schedule.	2	4	8
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error (Scrubber line valve not opened) during addition	Reactor may pressurise	1. PT is available in the reactor with high and high high alarms. 2. Reactor is designed pressure to 6 bar pressure. 3. PG is available on the reactor. 4.Trained manpower is deputed for operation.	3	4	12	1. Recommended to provide interlock to closed addition CV at high high alarm of PT. 2. Recommended to provide interlock to closed addition CV at high high alarm of PT of the scrubber pot. 3. Flash alarm to be provider on HH value of PT of the reactor. 4.Recommend to provide interlock to closed the steam TCV at HH pressure of the reactor.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of PT of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line manual valve pass/Left open due to human error		1.PT is available with high and high high alarm in reactor.	3	4	12	1.Double valve to be provided in N2 supply line.	2	4	8
			Thionyl chloride addition rate fast		Refer high flow safeguard	3	4	12				
			Scrubber circulation pump trip/stop		Pump running indication is available on DCS	3	4	12	1.Thionyl chloride addition line CV to be closed in case of circulation pump trip/stop.			
			Venturi chocked		Material having no chocking property.	3	4	12				
15	Temperature	Low	Cooling water supply valve opened/passed	No HSE hazard	1.RTD is provided in the reactor with low and low low alarm.	3	1	3				
		High	TI malfunction	Exotherm may possible in the reactor	1.TI is available in the utility supply and return line of the reactor. 2.Calibration of TI is performed before startup operation.	3	4	12	1.PM of critical instruments to be performed ass per predefined schedule.	2	4	8
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in reactor with high and high high alarm.	3	4	12	1.PM of TCV to be carried out as per predefined schedule. 2.Flash alarm to be provide on HH value of RTD of the reactor.	2	4	8
			Human error(TCV		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			bypass line passed/open)						condition with tagging.			
			Fast addition rate		Flowmeter & totaliser is available in the addition line.	3	4	12	1.Upper limit of flowmeter and totaliser to be freeze. 2.Interlock to be provide that at HH temperature of reactor thionyl chloride addition line CV to be stop. 3.Flash alarm to be provide on HH temperature of the reactor.	2	4	8
			Jacket puncture of the reactor		Before startup spark test & thickness testing is performed.	3	4	12				
16	Level	Low	Reactor Bottom valve left open/pass	Spillage and health hazard may possible	Trained manpower and SOP is available before line up.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	3	3	9	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all flanges.	2	3	6
			Reactor leakage		PM is performed before start-up and record is maintained.	3	3	9				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 8		**Node Description : Chlorination reactor(042RT-104)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Nitrogen inertisation is performed in the reactor before charging. 2. Double earthing/grounding is provided to the reactor. 3. Earthing continuity is ensured before start-up. 4.Double earthing is provided to hopper.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9	Thionyl chloride addition line CV air failed safe position to be air failed to closed condition.	2	3	6
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No load tripping is provided on agitator.	3	3	9	Thionyl chloride addition line CV to be closed in case of agitator stop/trip.	2	3	6

HAZOP study of MMBC Project

P &ID number : 8203/MMBC-STAGE-4/001		Title : HAZOP Study Of MMBC project at 8203 site							Plant Name: Plant 04, Date-11/12/2023			
Node 9		Node Description : solvent recovery reactor(041RT-106)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Solvent recovery from solvent recovery reactor(041RT-106)										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8
		High Vacuum	No probable cause	No HSE hazard								
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.				trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor. 4. Flash alarm to be provided at HH temperature of the reactor.			
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up. 3.Tantalum plug is provided in the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8
Stream-7		**Top Collection in receiver-500 LTR(043TK-250A) &(043TK-250B)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001		**Title : HAZOP Study Of MMBC project at 8203 site**							**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard due to spillage	1.All electrical installation are flameproof as per HAC classification. 2.Fire extinguisher and fire hydrant point is available near by area.	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in solvent recovery reactor	No HSE hazard/Process Delay	No existing safeguard.	3	1	3	1.Recommended to manually observe the level of reaction reactor during distillation at particular time interval .	2	1	2
			Loadcell malfunctioning	Overflow may possible from top collection receiver	1.Loadcell calibration is performed before startup. 2.No open vent in collection receiver.so, no chances of overflow.	3	2	6	1.PM of all critical instruments to be performed as per predefined schedule.	2	2	4
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Receiver vent is given in vacuum pot .so,no chances of overflow. 4.Material is compatible with utility.	3	3	9				
			Human error(Steam TCV more percentage open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.TI is available in distillation reactor with alarms.	3	1	3	1.At HH temperature of the solvent recovery reactor steam TCV to be closed.	2	1	2
		Reverse	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	Human error(Manual valve of reflux line is fully open instead of collection line)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.							
2	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	No HSE hazard/Process Delay								
		High	No probable cause	No HSE hazard/Process Delay								
3	Temperatur e	Low	No probable cause									
		High	Utility failure in condenser	Temperature rise may possible in receiver	1.TI is available in receiver with high and high high alarms. 2.TI is available in utility supply and return line of condenser.	3	3	9	1.utility circulation pump indication to be provide on DCS. 2.Solvent recovery rector steam TCV to be closed in case of utility circulation pump stop/trip or high high temperature of utility supply line.	2	3	6
4	Level	Low	Receiver leakage	Fire hazard and health hazard due to spillage	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Loadcell is available in the collection receiver	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					with low and low low alarms. 4.Thickness testing to be carried out as per PM schedule. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.							
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Human error (Withdrawal not done at regular interval)	Overflow may possible and lead to health hazard & fire hazard	1.Loadcell is available on receiver with high and high high alarms. 2.Receiver vent line is connected with vacuum pot.so, overflow is not possible.	3	3	9				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 9		**Node Description : solvent recovery reactor(041RT-106)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**Crude MMBC transfer to crude MMBC storage reactor(042RT-105)**										
1	Quantity/Flow	No/Less	Transferring pump trip/stops	No HSE hazard/process delay	No existing safeguard.	3	1	3				
			Human error (Discharge manual valve not opened).	Transferring line may pressurise	1. Trained manpower will deputed for drum charging. 2.line design pressure is sustained to resist maximum discharge pressure of pump. 3. Fire extinguishers are available in nearby places.	3	3	9	1. Spill kit to be provided to contain spillage.	3	3	9

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line/Flange leakage	Fire hazard/Spillage	1.Line leakage testing is done before start-up . 2.Compatible gasket is used. 3.All electrical installation are flameproof as per HAC classification. 4. Fire extinguishers are available in nearby places.	3	3	9	1. Spill kit to be provided at nearby area to contain the spillage. 2. Flange guard to be provided on all flanges.	2	3	6
			Human error(vent is not open in storage reactor)	Tank may pressurise	1.PT is available in the tank with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Tank design pressure is upto 6 bar.	3	4	12	1.Vent line valve should be locked open condition with tagging. 2.	2	4	8
			Vent line flame arrestor chocked		1.PM of flame arrestor is performed before startup. 2.Tank design pressure is upto 6 bar.	3	4	12	PM of flame arrestor to be performed as per predefined schedule.			
			Line chocked	Line may pressurise	1.Line design pressure is sustained to resist maximum discharge pressure of pump. 2.Material having no chocking property.	3	3	9				
		High/More	No probable cause									
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error (reactor vent line valve not opened)	Reactor may pressurise	1.PT is available in the reactor with high and high high alarms. 2.Trained manpower is deputed for operation. 3.Tank design pressure is upto 6 bar.	3	4	12	1. Flash alarm to be provided on HH pressure of the tank. 2. Vent valve should be in critical locked open condition & tag to be provide on that.	2	4	8
			Vent line flame arrestor chocked		1.Material having no chocking property. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.Flame arrestor PM to be performed before start up.	3	4	12	1.Flame arrestor preventive maintenance to be performed as per predefined schedule.	2	4	8
			N2 manual valve passed/left open		1.Vent is provided on reactor and verified by supervisor that valve is always open during process. 2.PT is available in reactor with high and high high alarms. 3.Reactor design pressure is upto 6 bar.	3	4	12	1.Double manual valve to be provide in N2 purging line.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No credible cause	-	TI is available in tank with low and low low alarms							
		High	No credible cause	-	TI is available in tank with high and high high alarms.							
4	Level	Low	Tank body leakage	Fire hazard/Spillage	1.Material is compatible with reactor MOC 2.Pressure testing is performed before startup. 3.Fire extinguishers are available in nearby places.	3	3	9	1.Spill kit to be provide to contain the spillage.'	2	3	6
			Tank bottom valve leakage/passed		Double manual valve to be provide at bottom of the day tank.	3	3	9	1.Spill kit to be provide to contain the spillage.'	2	3	6
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	3	3	9				
5	Composition	Other than	No credible cause									
6	Others	Static Electricity	-	Fire hazard	1. Earthing continuity is verified before startup. 2. Dual earthing is provided in the reactor. 3. Earthing strip is provided on the flanges.	3	3	9				
		Instrument Air	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 10		**Node Description : Crude MMBC storage reactor(042RT-105)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		failure										
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Product distillation from final distillation reactor(041RT-107)**										
1	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor with high and high high alarms. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 2. Interlock to be provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 4. Flash alarm to be provided at HH temperature and HH pressure of the reactor.	2	4	8
		High Vacuum	No probable cause	No HSE hazard								
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. CWS supply provision is available to reactor. 3. Leakage test is performed before start-up. 4. Compound PT is available on the reactor. 5. TI is available in the reactor & condenser vent line with high and high high alarms.	3	4	12	1. Recommend to provide interlock to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 2. Interlock to be provided to stop steam CV at vacuum drop & vacuum pump trip/stops. 3. Interlock to be provided to stop steam line TCV at HH temperature of the reactor.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									4. Flash alarm to be provided at HH temperature of the reactor.			
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12	1.PM of TCV is to be performed as per predefined schedule.	2	4	8
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	3	4	8				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification.	3	3	9	1. Double manual valve to be provide to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
			Condenser leakage		1.PM is performed before startup.	3	3	9				
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up. 3.Tantalum plug is provided in the reactor.	3	3	9				
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	4	12	1.TCV of steam line air failed safe position to be air fail to close. 2.PCV of vacuum pot air fail safe position to be air fail to close. 3.ROV of vacuum line air fail safe position to be air fail to open.	2	4	8
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	No existing safeguard	3	4	12	1.Agitator no load tripping to be provided. 2.Steam TCV to be closed in case of agitator stop/trip.	2	4	8
Stream-2		**Top Collection in receiver-500 LTR(043TK-251A) &(043TK-251B)**										
7	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard due to spillage	1.All electrical installation are flameproof as per HAC classification. 2.Fire extinguisher and fire hydrant point is available near by area.	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			No/low level in solvent recovery reactor	No HSE hazard/Process Delay	No existing safeguard.	3	1	3	1.Recommended to manually observe the level of final distillation reactor during distillation at particular time interval .	2	1	2
			Loadcell malfunctioning	Overflow may possible from top collection receiver	1.Loadcell calibration is performed before startup. 2.No open vent in collection receiver.so, no chances of overflow.	3	2	6	1.PM of all critical instruments to be performed as per predefined schedule.	2	2	4
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Receiver vent is given in vacuum pot .so,no chances of overflow. 4.Material is compatible with utility.	3	3	9				
			Human error(Steam TCV more percentage open)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.TI is available in distillation reactor with alarms.	3	1	3	1.At HH temperature of the solvent recovery reactor steam TCV to be closed.	2	1	2
		Reverse	No probable cause									
		Mis-directed flow	Human error(Manual valve of reflux line is fully open insted of collection line)	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation.							
8	Pressure	Low	1. Line leakage 2. Vacuum	No HSE hazard/Process Delay								

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			pump trip/stops									
		High	No probable cause	No HSE hazard/Process Delay								
9	Temperature	Low	No probable cause									
		High	Utility failure in condenser	Temperature rise may possible in receiver	1.TI is available in receiver with high and high high alarms. 2.TI is available in utility supply and return line of condenser.	3	3	9	1.utility circulation pump indication to be provide on DCS. 2.Final distillation reactor steam TCV to be closed in case of utility circulation pump stop/trip or high high temperature of utility supply line.	2	3	6
10	Level	Low	Receiver leakage	Fire hazard and health hazard due to spillage	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Loadcell is available in the collection receiver with low and low low alarms. 4.Thickness testing to be carried out as per PM schedule. 5.All electrical installation are flameproof as per HAC classification. 6.Fire extinguisher and fire hydrant point is available near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 11		**Node Description : Final distillation reactor(041RT-107)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Human error (Withdrawal not done at regular interval)	Overflow may possible and lead to health hazard & fire hazard	1.Loadcell is available on receiver with high and high high alarms. 2.Receiver vent line is connected with vacuum pot.so,overflow is not possible.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing/grounding is provided to the reactor. 2. Earthing continuity is ensured before start-up.	3	3	9				
		Instrument Air failure	No probable cause									
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project			
P &ID number : 8203/MMBC-STAGE-4/001	**Title : HAZOP Study Of MMBC project at 8203 site**		**Plant Name: Plant 04, Date-11/12/2023**
Node 12	**Node Description : Pure MMBC storage tank(041ST-160)**		

Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		**Material loading and unloading in MMBC storage tank(041ST-160)**										
1	Quantity/Flow	No/Less	Transferring/unloading pump trip/stops	No HSE hazard/Process delay	1.Unloading pump running indication is provided on DCS. 2.LI is available in storage tank to monitor the level of tank.	3	1	3				
			Line/Flange leakage	Health and fire hazard due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Compatible gasket to be used to prevent gasket leakage.	2	3	6

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Material receiving line Valve not opened)	No HSE hazard/Process delay								
			PVRV chocked/malfunctioning	Tank may implode	1.PT is available in tank low and low low alarm. 2.PM is performed before startup.	3	4	12	1. Flash alarm to be provided on LL value of PT of the tank. 2. Interlock to be provided to stop unloading pump at LL alarm value of PT of the storage tank.	2	4	8
		High/More	LI malfunctioning	Overflow from tank may lead to gas/liquid exposure due to spillage.	1.PM of critical instrument is performed before startup.	3	3	9	1.PM to be performed as per predefined schedule.	2	3	6
		Reverse	Pump trip/stops	Pump mechanical failure	NRV to be provide in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
		Low	PVRV chocked/malfunctioning	Tank may implode	1.PT is available on tank with low and low alarm. 1.PM is carried out	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					before start operation.							
		High	PVRV chocked/malfunctioning	Tank may pressurise	1.PT is available on tank with low and low alarm. 2.PM is carried out before start operation.	3	4	12	1.PVRV PM to be performed as per pre-defined schedule.	2	4	8
			N2 line manual valve pass		1.PRV is available in N2 line. 2.PT is available in tank high and high high alarm. 3.PVRV is available in tank.	3	4	12	1.Double manual valve to be provide in N2 line. 2.Flash alarm to be provide on HH value of PT of the storage tank.	2	4	8
			N2 PRV failure		1.PT is available in tank high and high high alarm. 2.PVRV is available in tank.	3	4	12	1.PM to be performed of PRV as per predefined schedule.	2	4	8
3	Temperature	Low	No credible cause	-	TI is available in reactor with							

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					low and low low alarms							
		High	No credible cause	-	TI is available in reactor with high and high high alarms.							
4	Level	Low	Refer low Flow									
			Tank body leakage	Health and fire hazard due to spillage	1. Tank MOC is compatible with material. so leakage is not possible. 2. Dyke is available 3.Fire extinguisher and fire hydrant point is available in near by area. 4.All electrical installation are flameproof as per HAC classification .	3	3	9	1.Thickness testing of tank to be performed as per predefined schedule.	2	3	6
			Tank bottom valve passed/leakage						1.Double manual valve to be provide at bottom of the tank.	2	3	6
		High	Refer high Flow									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-STAGE-4/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 12		**Node Description : Pure MMBC storage tank(041ST-160)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than										
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the storage tank. 2. Earthing jumpers are provided to all the flanges.	2	3	6	Nitrogen inertisation to be performed in the tank.			
		Instrument Air failure	No credible cause	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**Reaction in scrubber tank (040TK-252)**										
1	Quantity/Flow	No/Less	Scrubber circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS . 2.Vent line of scrubber column is given in secondary column.so,less chances of gas exposure.	3	3	9	1.Flash alarm to be provide on trip/stop of scrubber circulation pump. 2.Recommend to provide interlock to closed the thionyl addition line CV of chlorination reactor when scrubber circulation pump stop/trip. .	2	3	6
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	4	3	12	1.Pump discharge valve should be critical locked open condition and tag to be provide on that.	2	3	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	No existing safeguard	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			NRV chocked in pump discharge line	Transferring line may pressurise and can lead to spillage/health hazard	Compatible MOC of NRV is used so chocking not possible.	2	3	6				
		High/More	Graphite condenser leakage	Scrubber tank may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Scrubber tank vent is given in scrubber column.so,no chances of overflow.	3	3	9	1.Flash alarm to be provide on high high value of LI of scrubber tank. 2.Recommend to provide interlock to closed the thionyl addition line CV of chlorination reactor at HH value of LI of HCl receiver of scrubber tank.	2	3	6
			Circulation pump run at high frequency	No HSE hazard	1.Pump running frequency is fixed after stabilize the process.	2	1	2				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV is available in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
2	Pressure	Low	No probable cause	-	-				-			
		High	Vent line valve not opened (Human Error)	Scrubber tank may pressurise	1.PT is available on the tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of primary scrubber tank. 3.Recommend to provide interlock to closed the thionyl chloride addition line CV at HH pressure of HCL receiver of scrubber tank.	2	4	8
			Caustic scrubber reactor circulation pump stop/trip		1.Pump running indication is available o DCS.	3	4	12				
			Venturi chocked		1.Material having no chocking property. 2.PM of venturi is performed before start operation.							
3	Temperature	Low	No credible cause	-	TI is available in receiver with low and low low alarms							
		High	Utility failure in jacket of the tank	Temperature rise may possible in scrubber tank	1.TI is available in HCl receiver with high and high high alarms. 2.TI is available in utility supply and return line of scrubber tank with alarms. 3.TI is available in utility return line of the absorber column.	3	4	12	1.Utility circulation pump indication to be provide on DCS.	2	4	8
			Utility failure in jacket of the absorber column									

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Refer low Flow									
		Low level in tank	Tank leakage	Gas/Liquid Exposure due to spillage	Receiver MOC is compatible so leakage is not possible	2	3	6	1.Spill kit to be provided in nearby area to contain spillage.	1	3	3
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	2	3	6				
5	Composition	Other than	No probable cause									
6	Others	Static Electricity		No HSE hazard								
		Instrument Air failure		No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream -2		**Reaction in caustic scrubber tank (040RT-109)**										

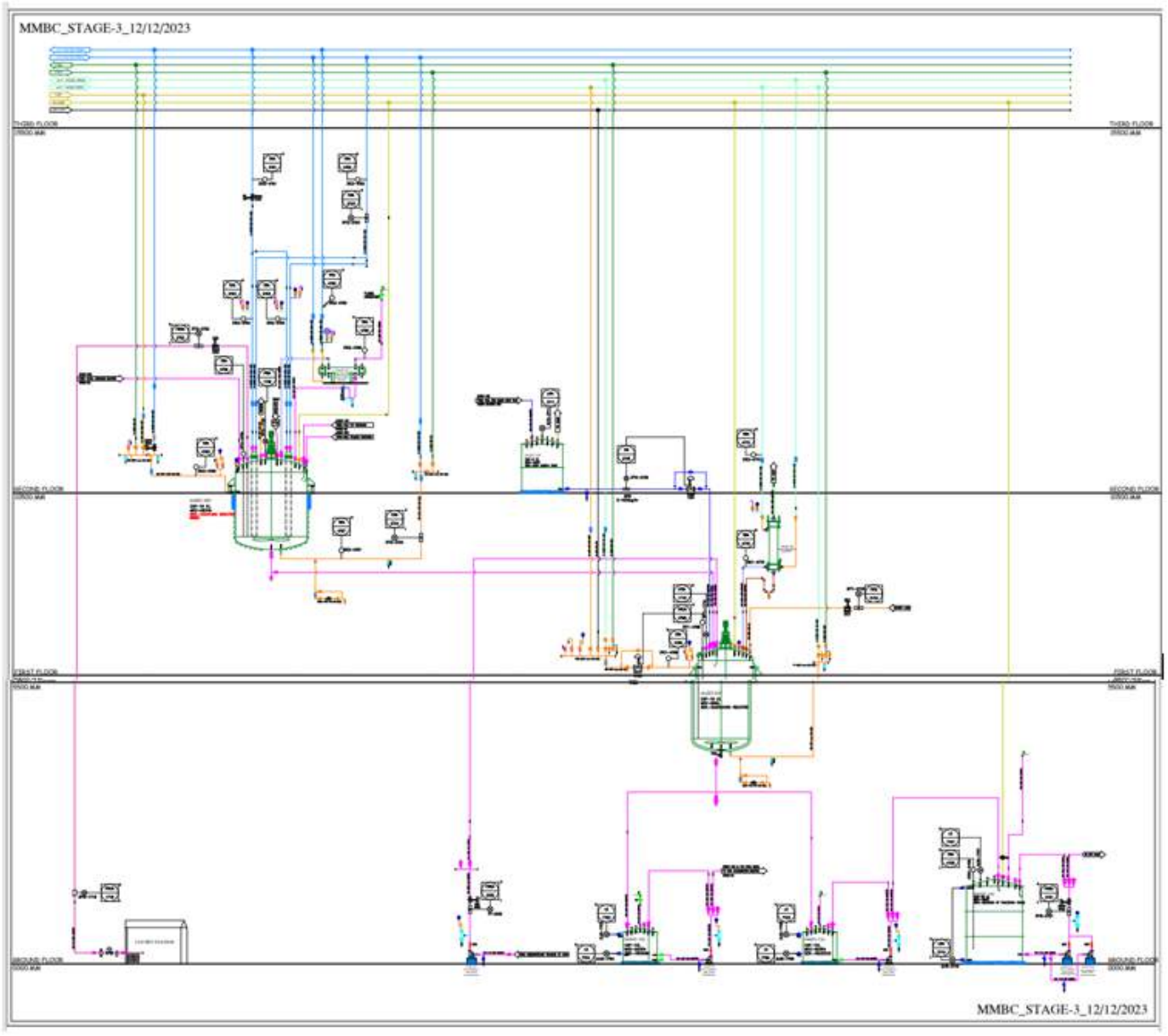
HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Caustic Scrubber circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS .	3	3	9	1.Flash alarm to be provide on trip/stop of caustic scrubber circulation pump. 2.Recommend to provide interlock to closed the thionyl addition line CV of chlorination reactor when scrubber circulation pump stop/trip. .	2	3	6
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	4	3	12	1.Pump discharge valve should be critical locked open condition and tag to be provide on that.	2	3	8

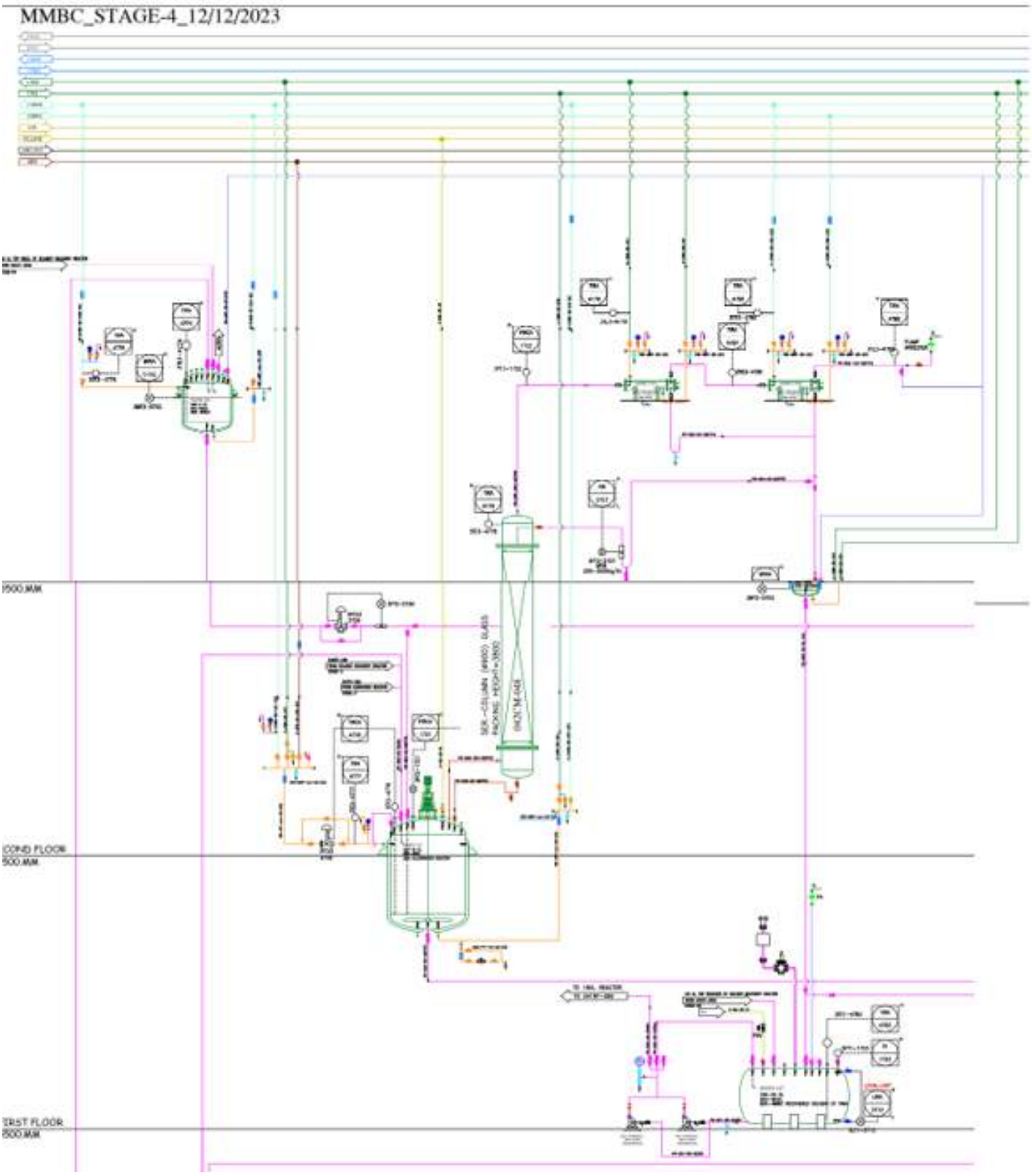
HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	No existing safeguard	3	3	9	1.Recommend to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provided in the nearby area to contain spillage.	2	3	6
			NRV chocked in pump discharge line	Transferring line may pressurise and can lead to spillage/health hazard	Compatible MOC of NRV is used so chocking not possible.	2	3	6				
		High/More	Circulation pump run at high frequency	No HSE hazard	1.Pump running frequency is fixed after stabilize the process.	2	1	2				
		Reverse	Pump trip/stops	Pump mechanical failure	NRV is available in the pump discharge line to prevent reverse flow.	3	3	9				
		Mis-directed flow	No probable cause	-	-				-			
8	Pressure	Low	No probable cause	-	-				-			
		High	Vent line valve not opened (Human Error)	Scrubber tank may pressurise	1.PT is available on the tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag. 2. Flash alarm to be provided on HH alarm value of PT of caustic scrubber tank. 3.Recommend to provide interlock to closed the thionyl	2	4	8

HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
									chloride addition line CV at HH pressure of caustic scrubber reactor.			
9	Temperature	Low	No credible cause	-	TI is available in receiver with low and low low alarms							
		High	Utility failure in jacket of the tank	Temperature rise may possible in scrubber tank	1.TI is available in caustic scrubber reactor with high and high high alarms. 2.TI is available in utility supply and return line of scrubber reactor with alarms.	3	4	12	1.Utility circulation pump indication to be provide on DCS.	2	4	8
10	Level	Low	Refer low Flow									
			Tank leakage	Gas/Liquid Exposure due to spillage	Receiver MOC is compatible so leakage is not possible	2	3	6	1.Spill kit to be provided in nearby area to contain spillage.	1	3	3
		High	Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	Before startup spark test & thickness testing is performed.	2	3	6				

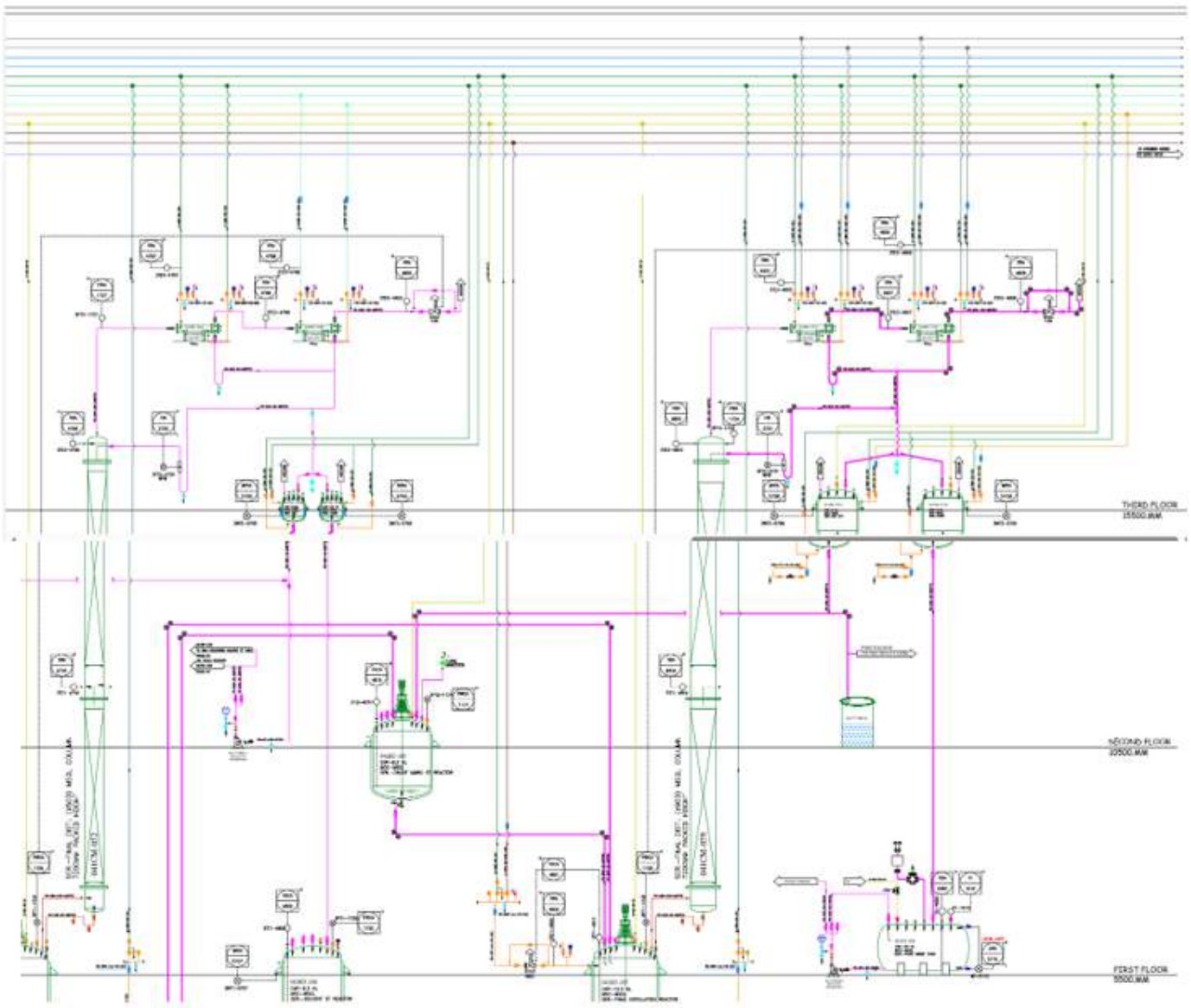
HAZOP study of MMBC Project												
P &ID number : 8203/MMBC-Scrubber system/001			**Title : HAZOP Study Of MMBC project at 8203 site**						**Plant Name: Plant 04, Date-11/12/2023**			
Node 13		**Node Description : HCl receiver for scrubber(040TK-252)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	No HSE hazard								
		Instrument Air failure	-	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								

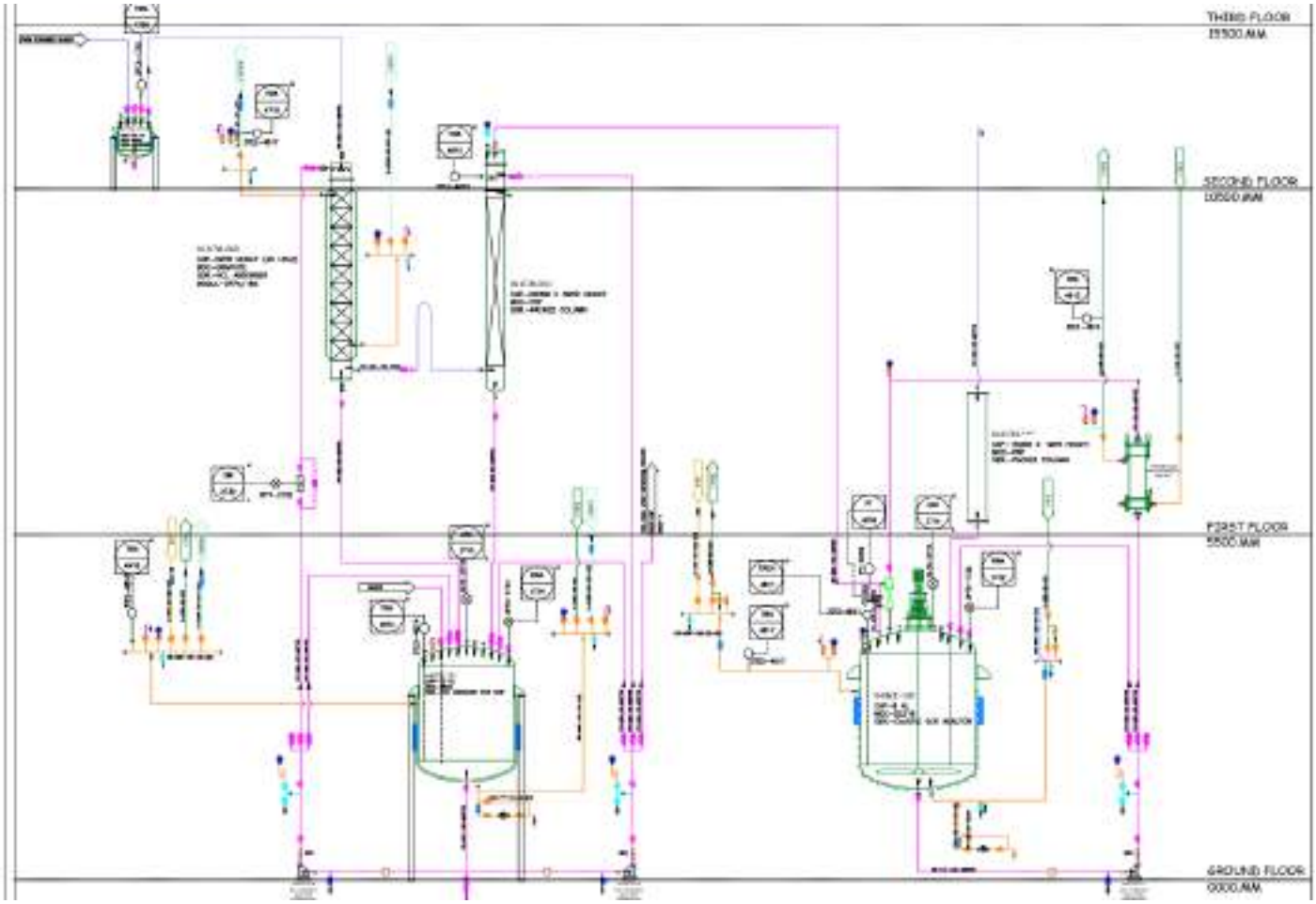
APPENDIX-2: P&IDs




MMBC_STAGE-4_12/12/2023
1500 MM
COND FLOOR
500 MM
1ST FLOOR
500 MM

2793


THIRD FLOOR
15500 MM
SECOND FLOOR
10500 MM
FIRST FLOOR
5500 MM



---- END OF THE REPORT -----

HAZOP - MMBC						
Sr No	Node	Stream	Recommendations	Department	Status	Page Ref. No.
1	1	1	Vent line manual valve to be in critical locked open condition with LO tag.	Mechanical	Completed	1
2	5	1	1. Vent line valve should be locked open.	Mechanical	Completed	2

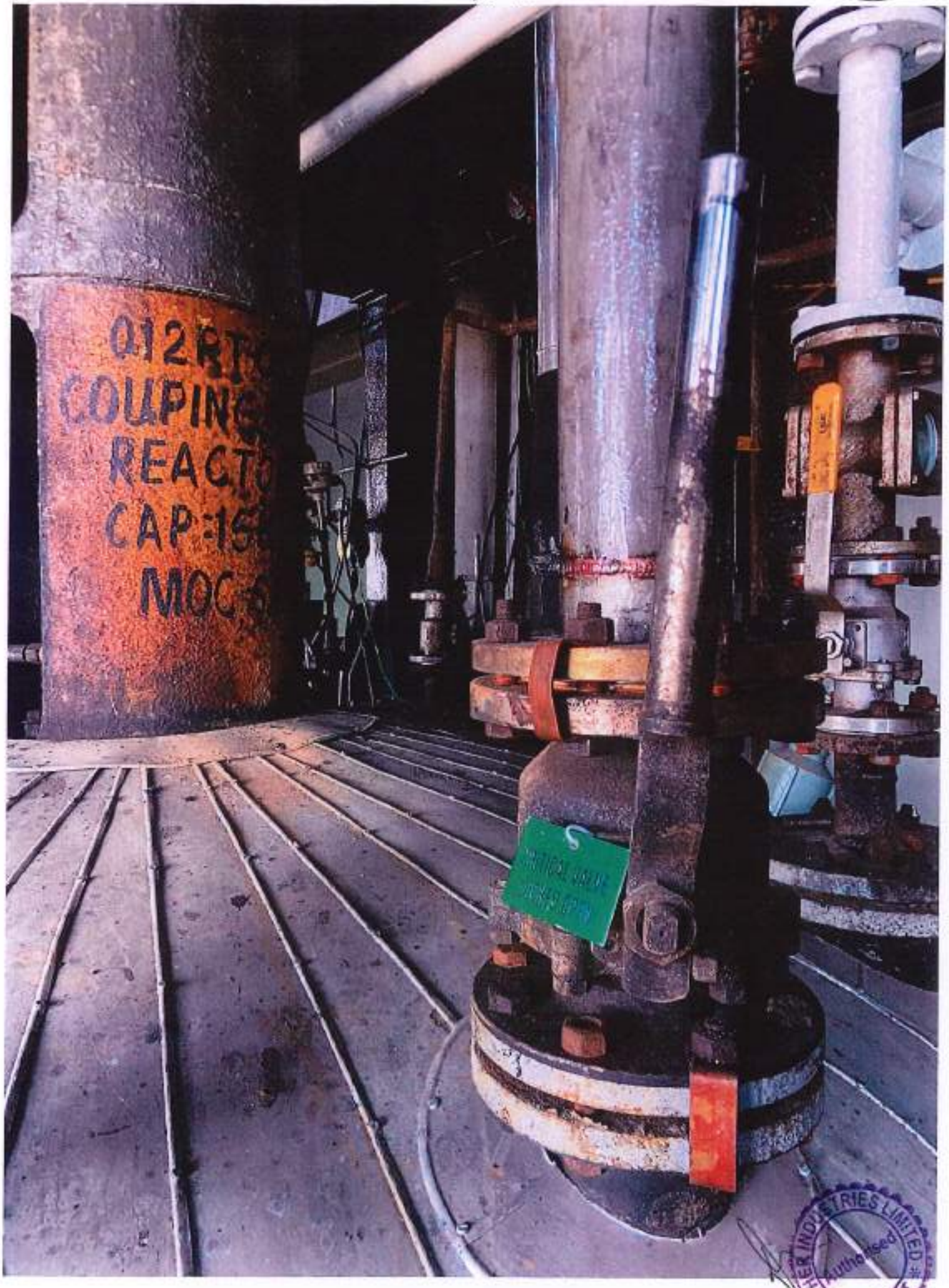


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2797 N-5.1 (2)


Q12RT
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METHER INDUSTRIES LIMITED
Authorised
SURAT

2798

HAZOP STUDY REPORT OF SOLVENT RECOVERY PLANT

M/S AETHER INDUSTRIES LTD.

SACHIN, SURAT

DECEMBER 2023

aether
elementally innovative



NEXA
Process Safety Engineers

2799

AETHER INDUSTRIES LTD.,

SURAT

aether
elementally innovative

HAZOP STUDY REPORT OF

SOLVENT RECOVERY PLANT

DECEMBER 2023

By

NEXA PROCESS SAFETY ENGINEERS

NEXA
Process Safety Engineers

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat **Proprietor**

12/12/2023 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Project SRP.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for BPCP Project.
It has 4 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	Extraction Column (CM-05)
2.	Continuous Distillation Column (CM-01)
3.	Continuous Distillation Column (CM-02)
4.	Continuous Distillation Column (CM-03)
5.	Continuous Distillation Column (CM-04)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will

cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.

Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

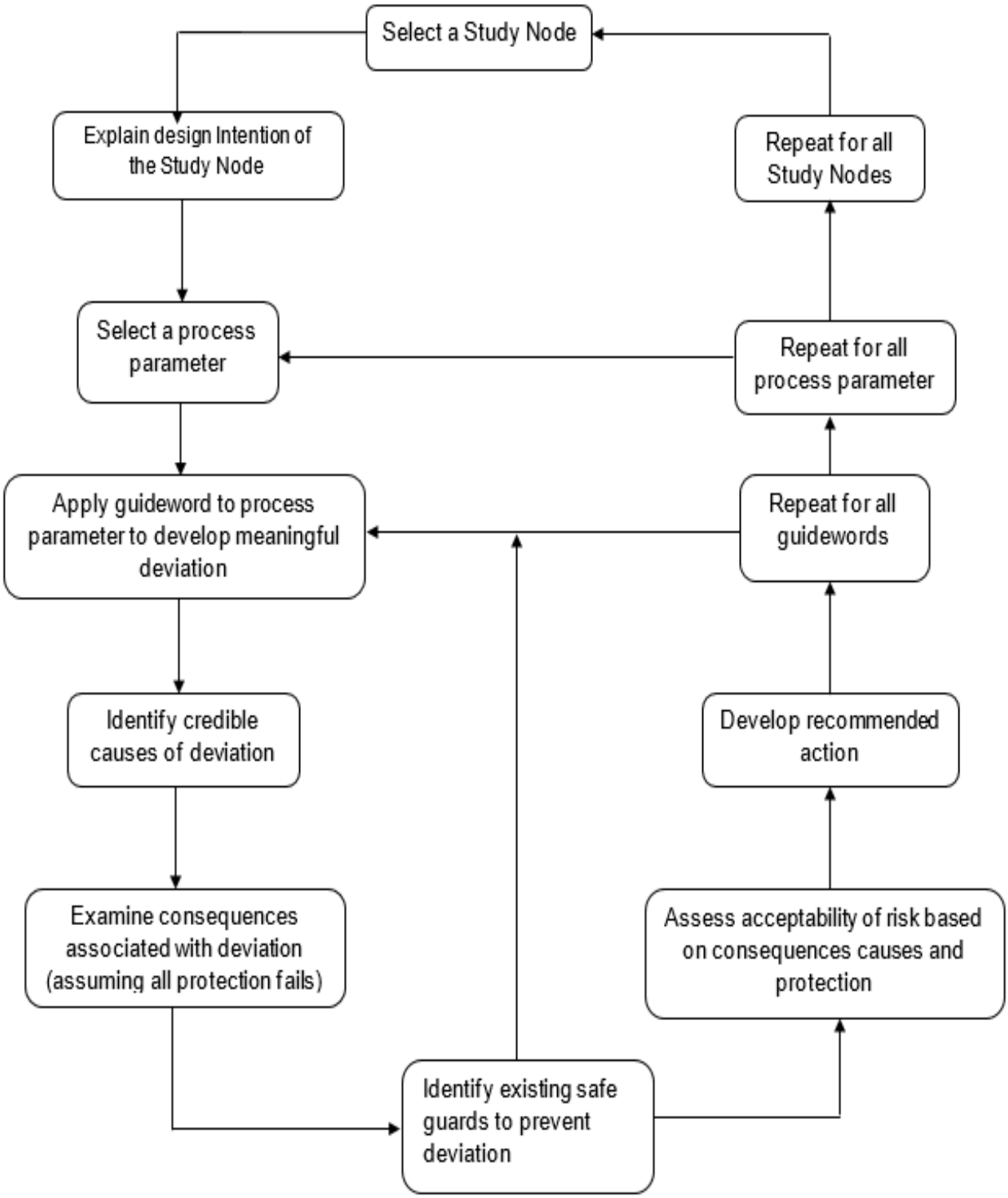
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	1- 4	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	5- 12	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	15- 25	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	Provided at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Sandeep Patel- R&D Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

The extract of the recommendation are summarised as below;

Node 1		Node Description : Extraction Column (CM-05)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1 : Continuous feeding from receiver (TK-01) to column(CM-05) through feeding pump(TP-010)						
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	No HSE hazard	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line.	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3. Interlock to be provided to that At HH value of loadcell of TK-017 feeding pump to be stopped.
Stream-2		**Mix solvent collection in receiver(TK-017)**				

Node 1		Node Description : Extraction Column (CM-05)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
2	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
3	Pressure	High	Human error(Manual vent valve is not opened)	Receiver may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms. 3. PVRV is available in the receiver.	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank. 3. Interlock to be provided to stop feeding pump at HH pressure of the receiver.
			Flame arrestor chocked in vent line		1.Material having no chocking property.	1.Flame arrestor PM to be performed before start up.
4	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.

Node 1		Node Description : Extraction Column (CM-05)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Bottom valve pass/leakage		No existing safeguard	1.Double valve is available to prevent valve passing/leakage.

Node 2		Node Description : Continuous Distillation Column (CM-01)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Continuous feeding from receiver (TK-017) to distillation column(CM-01) through feeding pump(TP-017)**				
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.

Node 2		Node Description : Continuous Distillation Column (CM-01)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2		**Continuous distillation in distillation column (CM-01)**				
2	Pressure	High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	1.Flame arrestor PM to be carried out as per define schedule.
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.

Node 2		Node Description : Continuous Distillation Column (CM-01)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	1.TCV bypass valve should be locked closed condition with tagging.
4	Level	High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	1.CV stroke testing to be carried out as per defined PM schedule.
5	Others	Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.

Node 2		Node Description : Continuous Distillation Column (CM-01)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-3		**Top collection in receiver(TK-05)**				
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in	1.Interlock to be provide that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.

Node 2		Node Description : Continuous Distillation Column (CM-01)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					final vent line.	
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	1. Flow meter PM to be done periodically.
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding pump and top & bottom collection CV to be closed.
7	Pressure	High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.
			Flame arrestor chocked in vent line		1.Material having no chocking property.	1.Flame arrestor PM to be performed before start up.

Node 2		Node Description : Continuous Distillation Column (CM-01)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
8	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
			Bottom valve pass/leakage		No existing safeguard	1.Double valve is available to prevent valve passing/leakage.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Continuous feeding to distillation column(CM-02) through feeding pump(CP-05-A/B)**				
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump & feeding line FCV close than top collection & bottom withdrawal CV to be closed.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2		**Continuous distillation in distillation column (CM-02)**				

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
2	Pressure	High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding line CV to be close and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	1.Flame arrestor PM to be carried out as per define schedule.
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	1.TCV bypass valve should be locked closed condition with tagging.
4	Level	High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump, Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	1.CV stroke testing to be carried out as per defined PM schedule.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
5	Others	Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.
Stream-3		**Top collection in receiver(TK-06)**				
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	1.Interlock to be provided that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed.
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	1. Flow meter PM to be done periodically.
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding line CV and top & bottom collection CV to be closed.
7	Pressure	High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.
			Flame arrestor chocked in vent line		1.Material having no chocking property.	1.Flame arrestor PM to be performed before start up.
8	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
			Bottom valve pass/leakage		No existing safeguard	1.Double valve is available to prevent valve passing/leakage.
Stream-4		**Bottom withdrawal in receiver (TK-04)**				

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
9	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	1.Flash alarm to be provided on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdraw pump stop/trip than at same time feeding pump to be stop and Steam TCV, bottom collection line CV to be closed.
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	1.Production supervisor need to confirm valve position before start operation.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.

Node 3		Node Description : Continuous Distillation Column (CM-02)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	1. Flow meter PM to be done periodically.
		High/More	Bottom collection CV passed	Overflow may possible	1.LI is available in receiver with high and high high alarm.	1.Interlock to be provided that at HH value of LI of storage tank bottom collection CV to be closed.
			Bypass valve of CV passed/left open			
10	Pressure	High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup.	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.
			Flame arrestor chocked in vent line		1.Material having no chocking property.	1.Flame arrestor PM to be performed before start up.
11	Level	Low	Tank leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI is available in the tank with low and low low alarms.	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
			Bottom valve pass/leakage		No existing safeguard	1.Double valve is available to prevent valve passing/leakage.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Continuous feeding from receiver (TK-04) to distillation column(CM-03) through feeding pump(TP-012)**				
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2		**Continuous distillation in distillation column (CM-03)**				
2	Pressure	High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	1.Flame arrestor PM to be carried out as per define schedule.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	1.TCV bypass valve should be locked closed condition with tagging.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
4	Level	High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	1.CV stroke testing to be carried out as per defined PM schedule.
5	Others	Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.
Stream-3		**Top collection in receiver(TK-07)**				
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area.	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					6.All electrical equipment are flameproof in near by area.	
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	1.Interlock to be provide that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	1. Flow meter PM to be done periodically.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding pump and top & bottom collection CV to be closed.
7	Pressure	High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.
			Flame arrestor chocked in vent line		1.Material having no chocking property.	1.Flame arrestor PM to be performed before start up.

Node 4		Node Description : Continuous Distillation Column (CM-03)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
8	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
			Bottom valve pass/leakage		No existing safeguard	1.Double valve is available to prevent valve passing/leakage.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
Stream-1		**Continuous feeding to distillation column(CM-04) through feeding pump(CP-07-A/B)**				
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump & feeding line FCV close than top collection & bottom withdrawal CV to be closed.
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					near by area. 6.All electrical equipment are flameproof in near by area.	
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.
Stream-2		**Continuous distillation in distillation column (CM-04)**				
2	Pressure	High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding line CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm.	1.Flame arrestor PM to be carried out as per define schedule.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					2. Choking not possible.	
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV to be closed.
3	Temperature	High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms.	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	1.TCV bypass valve should be locked closed condition with tagging.
4	Level	High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	1.CV stroke testing to be carried out as per defined PM schedule.
5	Others	Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.
Stream-3		**Top collection in receiver(TK-08)**				
6	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
					extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	1.Interlock to be provided that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV to be closed.
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	1. Flow meter PM to be done periodically.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding line CV and top collection CV to be closed.
7	Pressure	High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.
			Flame arrestor chocked in vent line		1.Material having no chocking property.	1.Flame arrestor PM to be performed before start up.

Node 5		Node Description : Continuous Distillation Column (CM-04)				
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**Recommendations**
8	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.
			Bottom valve pass/leakage		No existing safeguard	1.Double valve is available to prevent valve passing/leakage.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 1		Node Description : Extraction Column (CM-05)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		Continuous feeding from receiver (TK-01) to column(CM-05) through feeding pump(TP-010)										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 1		Node Description : Extraction Column (CM-05)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	No HSE hazard	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3. Interlock to be provided to that At HH value of loadcell of TK-017 feeding pump to be stopped.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**		
Node 1		**Node Description : Extraction Column (CM-05)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Mix solvent collection in receiver(TK-017)**										

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 1		Node Description : Extraction Column (CM-05)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 1		Node Description : Extraction Column (CM-05)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			No/low level in distillation column	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.							
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Receiver may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms. 3. PVRV is available in the receiver.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank. 3. Interlock to be provided to stop feeding pump at HH pressure of the receiver.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 1		**Node Description : Extraction Column (CM-05)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 1		Node Description : Extraction Column (CM-05)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from receiver (TK-017) to distillation column(CM-01) through feeding pump(TP-017)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					before startup.							
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-01)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		directed flow										
8	Pressure	Low	No probable cause									
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	2	3	6
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with high and high high alarms.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area. 3.All electrical equipment are flameproof in near by area.							
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	2	1	2
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(TK-05)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	1	1	1

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023				
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6	1. Flow meter PM to be done periodically.	2	2	4

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding pump and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 2		Node Description : Continuous Distillation Column (CM-01)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 2		**Node Description : Continuous Distillation Column (CM-01)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding to distillation column(CM-02) through feeding pump(CP-05-A/B)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump & feeding line FCV close than top collection & bottom withdrawal CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3	**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**		
Node 3		**Node Description : Continuous Distillation Column (CM-02)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-02)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding line CV to be close and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	2	3	6
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.	2	3	6

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with high and high high alarms.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area. 3.All electrical equipment are flameproof in near by area.							
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	2	1	2
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(TK-06)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	1	1	1

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provided that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6	1. Flow meter PM to be done periodically.	2	2	4

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding line CV and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal in receiver (TK-04)**										

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
19	Quantity/Flow		Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms.	3	3	9	1.Flash alarm to be provided on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdraw pump stop/trip than at same time feeding pump to be stop and Steam TCV, bottom collection line CV to be closed.	2	3	6
		No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 3		Node Description : Continuous Distillation Column (CM-02)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3	1.Production supervisor need to confirm valve position before start operation.	2	1	2
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay								
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay								
			Vent line valve is not open	No HSE hazard/Process Delay								
			Flow meter malfunction	Process delay	LI is available in receiver with low and low low alarms.	3	1	3	1. Flow meter PM to be done periodically.	2	1	2
		High/More	Bottom collection CV passed	Overflow may possible	1.LI is available in receiver with high and high high alarm.	3	3	9	1.Interlock to be provided that at HH value of LI of storage tank bottom collection CV to be closed.	2	3	6
			Bypass valve of CV passed/left open									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	3	3	9	1.Flame arrestor PM to be performed before start up.	2	3	6
21	Temperature	Low	No probable cause									
		High	No probable cause									
22	Level	Low	Tank leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2. LI is available in the tank with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
23	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 3		**Node Description : Continuous Distillation Column (CM-02)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from receiver (TK-04) to distillation column(CM-03) through feeding pump(TP-012)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					before startup.							
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-03)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		directed flow										
8	Pressure	Low	No probable cause									
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	2	3	6
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with high and high high alarms.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area. 3.All electrical equipment are flameproof in near by area.							
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023		
Node 4		Node Description : Continuous Distillation Column (CM-03)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	2	1	2
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(TK-07)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	1	1	1

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6	1. Flow meter PM to be done periodically.	2	2	4

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 4		Node Description : Continuous Distillation Column (CM-03)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding pump and top & bottom collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 4		**Node Description : Continuous Distillation Column (CM-03)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**		
Node 4		**Node Description : Continuous Distillation Column (CM-03)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding to distillation column(CM-04) through feeding pump(CP-07-A/B)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line.	4	1	4	1.Pump running indication to be provided on DCS. 2.Interlock to be provided that if feeding pump & feeding line FCV close than top collection & bottom withdrawal CV to be closed.	3	1	3
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Line is designed to resist maximum discharge pressure.	3	2	6				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area.	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provided to contain spillage.	2	3	6
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in the discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**						**Plant Name: Plant-4, Date- 06/12/2023**			
Node 5	**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	4	2	8	1.Feeding line flow meter upper limit to be freeze. 2.PM of feeding pump to be carried out as per define frequency. 3.Flash alarm to be provide on high high value of LI of column.	2	2	4
		Reverse	Pump trip/stops	Pump mechanical damage	NRV is available in pump discharge line.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**		
Node 5		**Node Description : Continuous Distillation Column (CM-04)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (CM-04)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2.3 no of PT is available in distillation column with high and high high alarm.	4	3	12	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding line CV to be closed. 2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	2	3	6
			Flame arrestor chocked in vent line		1.3 no of PT is available in distillation column with high and high high alarm. 2. Choking not possible.	3	3	9	1.Flame arrestor PM to be carried out as per define schedule.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV to be closed. 2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV to be closed.	2	3	6
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column	3	3	9	1.TCV stroke testing to be carried out as per define schedule. 2.Flash alarm to be provide on HH temperature of top and bottom of the column. 3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site							Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					with high and high high alarms.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by	2	3	6				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					area. 3.All electrical equipment are flameproof in near by area.							
		High	Reboiler circulation pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm.	3	1	3	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed. 2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	2	1	2
			Bottom withdrawal CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS.	3	1	3	1.CV stroke testing to be carried out as per defined PM schedule.	2	1	2
			Human error (Steam TCV is not open)		1.Steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column with HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3	1.Steam TCV air fail safe position to be air failed to close. 2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	2	1	2
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-3		**Top collection in receiver(TK-08)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2. Line design pressure need to be confirmed before startup.	2	3	6

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04			Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	No existing safeguard	3	3	9	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage. 2.Spill kit to be provide to contain spillage.	2	3	6
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	1	1	1

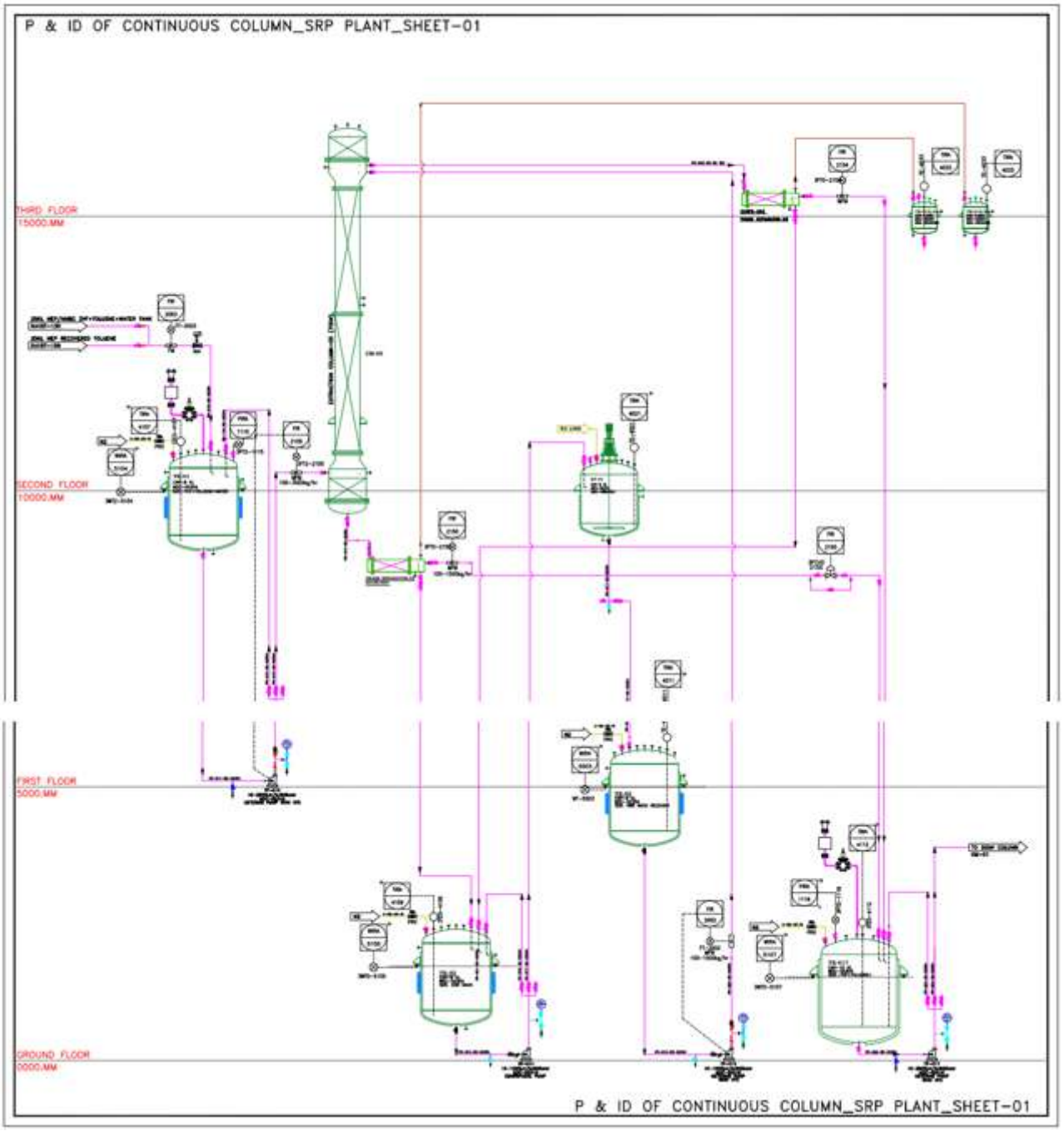
HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023				
Node 5		Node Description : Continuous Distillation Column (CM-04)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line.	3	3	9	1.Interlock to be provided that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV to be closed. 2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV to be closed.	2	3	6
			Top collection line CV stuck	No HSE hazard								
			Vent line valve is not open	No HSE hazard								
			Heating stopped	No HSE hazard/Process Delay								
			Flow meter malfunction	No HSE hazard/Process Delay	Load cell is available in receiver with low and low low alarms.	3	2	6	1. Flow meter PM to be done periodically.	2	2	4

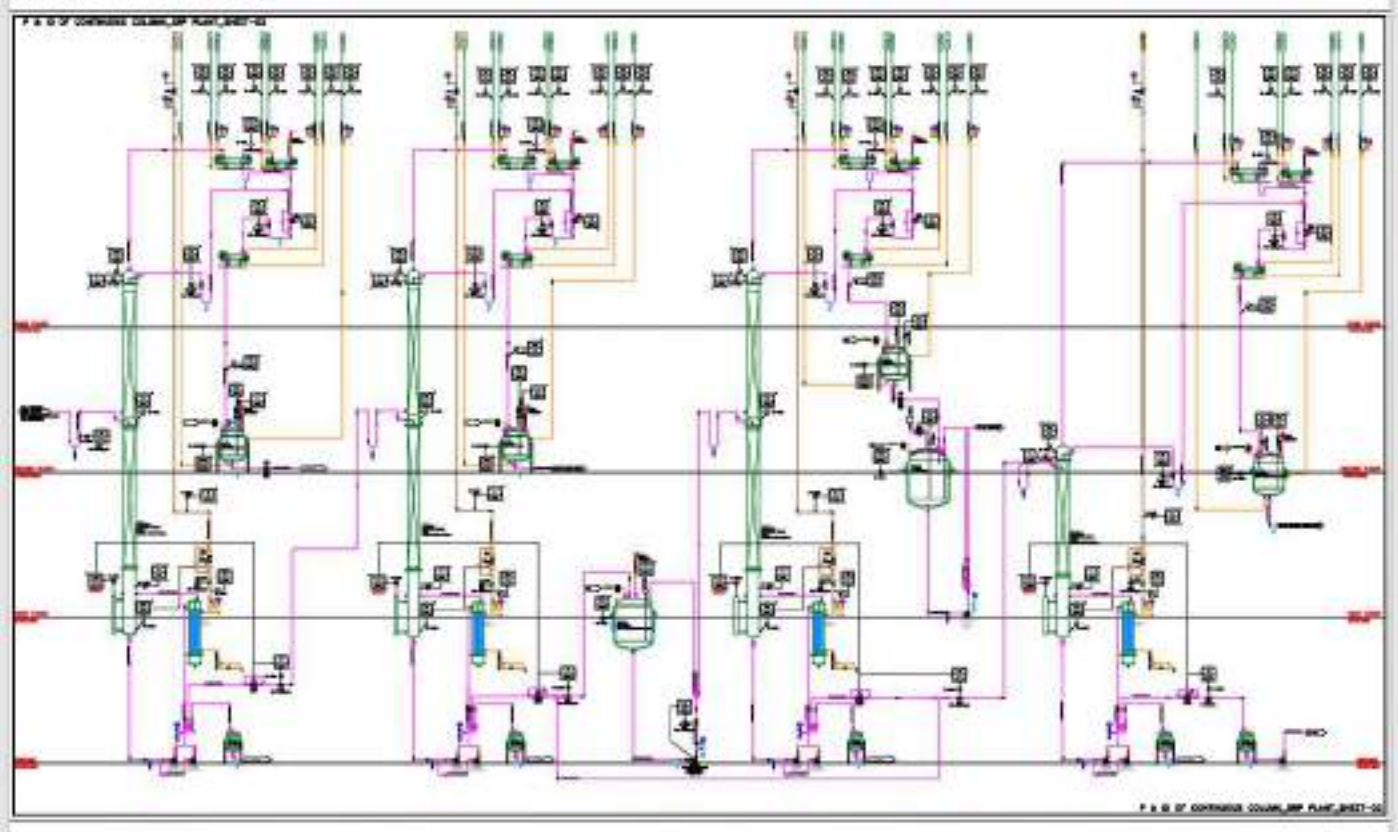
HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		Title : HAZOP study of SRP project at 8203 site						Plant Name: Plant-4, Date- 06/12/2023			
Node 5		Node Description : Continuous Distillation Column (CM-04)									
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser so,there are no chances of incompatibility hazard.	3	3	9	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	2	3	6
			Human error (Steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms.	4	3	12	1.Flash alarm to be provide on HH temperature of top of the column. 2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding line CV and top collection CV to be closed.	2	3	6
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

HAZOP study of SRP project at 8203 site												
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**			
Node 5		**Node Description : Continuous Distillation Column (CM-04)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms.	4	3	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve. 2. Flash alarm to be provided at HH pressure of tank.	2	2	4
			Flame arrestor chocked in vent line		1.Material having no chocking property.	4	3	12	1.Flame arrestor PM to be performed before start up.	2	3	6
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 6 bar. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms.	3	3	9	1. Spill kit to be provided in the nearby area to contain spillage. 2.Equipment thickness testing to be carried out as per define schedule.	2	3	6
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									

HAZOP study of SRP project at 8203 site											
P&ID of SRP_Plant-04		**Title : HAZOP study of SRP project at 8203 site**							**Plant Name: Plant-4, Date- 06/12/2023**		
Node 5		**Node Description : Continuous Distillation Column (CM-04)**									
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

APPENDIX-2: P&IDs





---- END OF THE REPORT -----

SRP HAZOP Report Recommendations Status

Node	Stream	Sr. No.	Recommendations Node Description : Extraction Column (CM-05)	Status	Action Taken	Page Ref. No.
Node 1	Stream-1		**Continuous feeding from receiver (TK-01) to column(CM-05) through feeding pump(TP-018)**			
	Stream-1	1	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-1	2	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-1	3	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-1	4	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	Stream-1	5	1.Feeding line flow meter upper limit to be fixed.	Completed	Implemented in DCS	4
	Stream-1	6	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	
	Stream-1	7	3. Interlock to be provided to that at HH value of level of TK-017 feeding pump to be stopped.	Completed	Implemented in DCS	4
	Stream-2		**Mix solvent collection in receiver(TK-017)**			
	Stream-2	8	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-2	9	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-2	10	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-2	11	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	Stream-2	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	5
	Stream-2	13	2. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	5
	Stream-2	14	3. Interlock to be provided to stop feeding pump at HH pressure of the receiver.	Completed	Implemented in DCS	4
	Stream-2	15	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	14
	Stream-2	16	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-2	17	2.Sudanmeter thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	13
	Stream-2	18	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	3
			Node Description : Continuous Distillation Column (CM-01)			
Node 2	Stream-1		**Continuous feeding from receiver (TK-017) to distillation column(CM-01) through feeding pump(TP-017)**			
	Stream-1	19	1.Pump running indication to be provided on DCS.	Completed	Implemented in DCS	7
	Stream-1	20	2.Interlock to be provided that if feeding pump to be stop then top collection & bottom withdraw CV to be closed.	Completed	Implemented in DCS	8
	Stream-1	21	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-1	22	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-1	23	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-1	24	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	Stream-1	25	1.Feeding line flow meter upper limit to be fixed.	Completed	Implemented in DCS	8
	Stream-1	26	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	16
	Stream-1	27	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	1
	Stream-2		**Continuous distillation in distillation column (CM-01)**			
	Stream-2	28	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed.	Completed	Implemented in DCS	10
	Stream-2	29	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	4
	Stream-2	30	3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	Completed	Implemented in DCS	10
	Stream-2	31	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	17
	Stream-2	32	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom	Completed	Implemented in DCS	8
	Stream-2	33	2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	Completed	Implemented in DCS	6
	Stream-2	34	1.TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in DCS	11
	Stream-2	35	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	13
	Stream-2	36	3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	8
	Stream-2	37	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	12
	Stream-2	38	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop than feeding pump,Steam TCV to be closed.	Completed	Implemented in DCS	9
	Stream-2	39	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	8
	Stream-2	40	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	11
	Stream-2	41	1.Steam TCV air fail safe position to be air failed to close.	Completed	Implemented in Field	-
	Stream-2	42	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	-
	Stream-3		**Top collection in receiver(TK-05)**			
	Stream-3	43	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	44	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2

	Stream-3	45	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-3	46	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	Stream-3	47	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	Completed	Implemented in DCS	8
	Stream-3	48	1.Interlock to be provide that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom	Completed	Implemented in DCS	8
	Stream-3	49	2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	Completed	Implemented in DCS	8
	Stream-3	50	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	13
	Stream-3	51	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	Completed	Implemented in DCS	9
	Stream-3	52	1.Flash alarm to be provide on HH temperature of top of the column.	Completed	Implemented in DCS	9
	Stream-3	53	2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding pump and top & bottom collection CV to be closed.	Completed	Implemented in DCS	8
	Stream-3	54	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	5
	Stream-3	55	2. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	9
	Stream-3	56	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in DCS	18
	Stream-3	57	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	58	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	19
	Stream-3	59	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	3
			Node Description : Continuous Distillation Column (CM-02)			
	Stream-1		**Continuous feeding to distillation column(CM-02) through feeding pump(CP-05-A/B)**			
	Stream-1	60	1.Pump running indication to be provided on DCS.	Completed	Implemented in DCS	20
	Stream-1	61	2.Interlock to be provided that if feeding pump & feeding line FCV close then top collection & bottom withdrawal CV to be closed.	Completed	Implemented in DCS	21
	Stream-1	62	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-1	63	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-1	64	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-1	65	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	Stream-1	66	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in DCS	21
	Stream-1	67	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	22
	Stream-1	68	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	9
	Stream-2		**Continuous distillation in distillation column (CM-02)**			
	Stream-2	69	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding line CV to be close and bottom collection CV to be closed.	Completed	Implemented in DCS	21
	Stream-2	70	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	5
	Stream-2	71	3.Flash alarm to be provide on HH pressure of top and bottom of the column PT	Completed	Implemented in DCS	9
	Stream-2	72	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	24
	Stream-2	73	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV and also bottom collection	Completed	Implemented in DCS	9
	Stream-2	74	2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed.	Completed	Implemented in DCS	9
	Stream-2	75	1.TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	11
	Stream-2	76	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	10
	Stream-2	77	3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	9
	Stream-2	78	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	12
	Stream-2	79	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop then feeding pump, Steam TCV to be closed.	Completed	Implemented in DCS	9
	Stream-2	80	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	9
	Stream-2	81	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	12
	Stream-2	82	1.Steam TCV air fail safe position to be air failed to close.	Completed	Implemented in Field	-
	Stream-2	83	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	-
	Stream-3		**Top collection in receiver(TK-06)**			
	Stream-3	84	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	85	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
Node 3	Stream-3	86	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-3	87	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	Stream-3	88	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	Completed	Implemented in DCS	9
	Stream-3	89	1.Interlock to be provided that at HH value of TI cooling water supply line in PHE Steam TCV to be closed and at a same time feeding line CV and also bottom collection	Completed	Implemented in DCS	9
	Stream-3	90	2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV and also bottom collection CV to be closed.	Completed	Implemented in DCS	9
	Stream-3	91	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	23
	Stream-3	92	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	Completed	Implemented in DCS	10
	Stream-3	93	1.Flash alarm to be provide on HH temperature of top of the column.	Completed	Implemented in DCS	10
	Stream-3	94	2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding line CV and top & bottom collection CV to be	Completed	Implemented in DCS	21
	Stream-3	95	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	Stream-3	96	2. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	13

	Stream-3	97	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	28
	Stream-3	98	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	99	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	2
	Stream-3	100	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-4		**Bottom withdrawal in receiver (TK-04)**			
	Stream-4	101	1.Flash alarm to be provided on HH value of LI of sump of distillation column.	Completed	Implemented in DCS	9
	Stream-4	102	2.Interlock to be provide that if bottom withdraw pump stopping then at same time feeding pump to be stop and Steam TCV, bottom collection line CV to be closed.	Completed	Implemented in DCS	31
	Stream-4	103	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-4	104	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-4	105	1.Production supervisor need to confirm valve position before start operation.	Completed	Implemented in Field	-
	Stream-4	106	1.Recommended to provide double valve provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-4	107	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	Stream-4	108	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	26
	Stream-4	109	1.Interlock to be provided that at HH value of LI of storage tank bottom collection CV to be closed.	Completed	Implemented in DCS	21
	Stream-4	110	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	Stream-4	111	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	27
	Stream-4	112	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-4	113	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	2
	Stream-4	114	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	3
			Node Description : Continuous distillation Column (CM-03)			
Node 6	Stream-1		**Continuous feeding from receiver (TK-04) to distillation column(CM-03) through feeding pump(TP-012)**			
	Stream-1	115	1.Pump running indication to be provided on DCS.	Completed	Implemented in DCS	28
	Stream-1	116	2.Interlock to be provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	Completed	Implemented in DCS	29
	Stream-1	117	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-1	118	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-1	119	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-1	120	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	Stream-1	121	1.Feeding line flow meter proper limit to be freeze.	Completed	Implemented in Field	29
	Stream-1	122	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	30
	Stream-1	123	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	9
	Stream-2		**Continuous distillation in distillation column (CM-03)**			
	Stream-2	124	1.At HH pressure of top and bottom of the column PT steam TCV to be closed and at a same time feeding pump to be stop and bottom collection CV to be closed.	Completed	Implemented in DCS	29
	Stream-2	125	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	Stream-2	126	3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	Completed	Implemented in DCS	10
	Stream-2	127	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	31
	Stream-2	128	1.Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom	Completed	Implemented in DCS	28
	Stream-2	129	2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	Completed	Implemented in DCS	28
	Stream-2	130	1.TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	11
	Stream-2	131	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	10
	Stream-2	132	3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed and same time bottom collection CV to be closed.	Completed	Implemented in DCS	28
	Stream-2	133	1.TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	12
	Stream-2	134	1.Interlock to be provide that in case of bottom withdrawal pump trip/stop then feeding pump,Steam TCV to be closed.	Completed	Implemented in DCS	28
	Stream-2	135	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	28
	Stream-2	136	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	11
	Stream-2	137	1.Steam TCV air fail safe position to be air failed to close.	Completed	Implemented in Field	-
	Stream-2	138	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	-
	Stream-3		**Top collection in receiver(TK-07)**			
	Stream-3	139	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	140	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-3	141	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-3	142	2.Spill kit to be provide to contain spillage.	Completed	Implemented in Field	1
	Stream-3	143	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	Completed	Implemented in DCS	28
	Stream-3	144	1.Interlock to be provide that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding pump to be stop and also bottom	Completed	Implemented in DCS	28
	Stream-3	145	2. At HH temperature of final vent line steam TCV to be closed and at a same time feeding pump to be stop and also bottom collection CV to be closed.	Completed	Implemented in DCS	28
	Stream-3	146	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	33
	Stream-3	147	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	Completed	Implemented in DCS	9

	Stream-3	148	1.Flash alarm to be provide on HH temperature of top of the column.	Completed	Implemented in DCS	9
	Stream-3	149	2.Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding pump and top & bottom collection CV to be closed.	Completed	Implemented in DCS	29
	Stream-3	150	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	Stream-3	151	2. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	8
	Stream-3	152	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	33
	Stream-3	153	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	154	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	34
	Stream-3	155	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	2
Node			Node Description : Continuous Distillation Column (CM-04)			
	Stream-1		Continuous feeding to distillation column(CM-04) through feeding pump(CP-07-A/B)			
	Stream-1	135	1.Pump running indication to be provided on DCS.	Completed	Implemented in Field	39
	Stream-1	137	2.Interlock to be provided that if feeding pump & feading line FCV close then top collection & bottom withdrawal CV to be closed.	Completed	Implemented in DCS	35
	Stream-1	138	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-1	139	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-1	140	1.Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-1	141	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	Stream-1	142	1.Feeding line flow meter upper limit to be freeze.	Completed	Implemented in Field	35
	Stream-1	143	2.PM of feeding pump to be carried out as per define frequency.	Completed	Implemented in Field	36
	Stream-1	144	3.Flash alarm to be provide on high high value of LI of column.	Completed	Implemented in DCS	10
	Stream-2		Continuous distillation in distillation column (CM-04)			
	Stream-2	166	1.At HH pressure of top and bottom of the column PT, steam TCV to be closed and at a same time feeding line CV to be closed.	Completed	Implemented in DCS	35
	Stream-2	166	2.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	Stream-2	167	3.Flash alarm to be provide on HH pressure of top and bottom of the column PT.	Completed	Implemented in DCS	9
	Stream-2	168	1.Flame arrestor PM to be carried out as per define schedule.	Completed	Implemented in Field	37
	Stream-2	169	1. Interlock to be provide that at HH value of TI the cooling water supply line in PHE ,Steam TCV to be closed and at a same time feading line CV to be closed.	Completed	Implemented in DCS	35
	Stream-2	170	2.At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV to be closed.	Completed	Implemented in DCS	35
	Stream-2	171	1. TCV stroke testing to be carried out as per define schedule.	Completed	Implemented in Field	11
	Stream-2	172	2.Flash alarm to be provide on HH temperature of top and bottom of the column.	Completed	Implemented in DCS	9
	Stream-2	173	3.Interlock to be provide that at HH temperature of top & bottom of the column Steam TCV to be closed.	Completed	Implemented in DCS	35
	Stream-2	174	1. TCV bypass valve should be locked closed condition with tagging.	Completed	Implemented in Field	12
	Stream-2	175	1.Interlock to be provide that in case of bottom withdrawal pump tripstop train feeding pump,Steam TCV to be closed.	Completed	Implemented in DCS	35
Node 3	Stream-2	176	2.Interlock to be provide that at HH value of LI of column feeding pump to be stop.	Completed	Implemented in DCS	35
	Stream-2	177	1.CV stroke testing to be carried out as per defined PM schedule.	Completed	Implemented in Field	11
	Stream-2	178	1.Steam TCV air fail safe position to be air failed to close.	Completed	Implemented in Field	11
	Stream-2	179	2.Distillation column top collection & bottom collection CV air fail safe position is air failed closed.	Completed	Implemented in Field	1
	Stream-3		Top collection in receiver(TK-08)			
	Stream-3	160	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	161	2. Line design pressure need to be confirmed before startup.	Completed	Implemented in Field	2
	Stream-3	162	1. Recommended to provide double valve/blind provision to prevent valve passing/leakage.	Completed	Implemented in Field	3
	Stream-3	163	2.Spill kit to be provided to contain spillage.	Completed	Implemented in Field	1
	Stream-3	164	1.Recommend to provide interlock that at LL value of LI of column, Steam TCV and bottom withdraw CV to be closed.	Completed	Implemented in DCS	35
	Stream-3	165	1.Interlock to be provided that at HH value of TI cooling water supply line in PHE ,Steam TCV to be closed and at a same time feeding line CV to be closed.	Completed	Implemented in DCS	35
	Stream-3	185	2. At HH temperature of final vent line Steam TCV to be closed and at a same time feeding line CV to be closed.	Completed	Implemented in DCS	35
	Stream-3	187	1. Flow meter PM to be done periodically.	Completed	Implemented in Field	38
	Stream-3	188	1.Flash alarm to be provide on high high value of Loadcell & level switch activation of receiver.	Completed	Implemented in DCS	9
	Stream-3	189	1.Flash alarm to be provide on HH temperature of top of the column.	Completed	Implemented in DCS	9
	Stream-3	190	2. Interlock to be provided that at HH temperature of top of the column Steam TCV to be closed and same time feeding line CV and top collection CV to be closed.	Completed	Implemented in DCS	35
	Stream-3	191	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Completed	Implemented in Field	3
	Stream-3	192	2. Flash alarm to be provided at HH pressure of tank.	Completed	Implemented in DCS	9
	Stream-3	193	1.Flame arrestor PM to be performed before start up.	Completed	Implemented in Field	40
	Stream-3	194	1. Spill kit to be provided in the nearby area to contain spillage.	Completed	Implemented in Field	1
	Stream-3	195	2.Equipment thickness testing to be carried out as per define schedule.	Completed	Implemented in Field	2
	Stream-3	196	1.Double valve is available to prevent valve passing/leakage.	Completed	Implemented in Field	3

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Spill Kit



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	Stream-3	140	
Node 5	Stream-1	159	
	Stream-3	181	
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www.kmsteelindia.com
Skype : milap.jain1

K.M. STEEL INDIA

AN ISO 9001:2008 CERTIFIED COMPANY

Rgd. Office : 122/c, Gora Gandhi Building, 1st floor, Office No. 37, 8th Khatwadi Back Road, Mumbai - 400004.
Tel.: 022 66394590 / 66362239
Mob.: +91 9869714760 / 9892372108

P.M.I. TEST REPORT

CUSTOMER NAME: - Aether Industries Limited.

PAGE NO: - 100.

ADD: - Plot no-8203, Road No. 08, GIDC Industrial Estate
Sachin, Surat - 394 230 Gujarat, India.

LAB TEST DATE: - 05 / DEC / 2023.

Details As Per P.O Copy.

MAT.SPECIFICATION: – S.S. 304 SEAMLESS PIPE - 1" NB X SCH 40 – N230917AS12.

P.O.NO: – AIL/PO/23-24/6529.

MAT.SPECIFICATION: – S.S. 304 SEAMLESS PIPE - 1-1/2" NB X SCH 40 – N230917AS12.

DATE: – 03 / DEC / 2023.

MAT.SPECIFICATION: – S.S. 304 SEAMLESS PIPE - 2" NB X SCH 40 – N230917AS12.

Chemical Composition (%).

S No.	Size	C%	Mn%	P%	S%	Si%	Cr%	Ni%			
	MIN						18.00	8.00			
	MAX	0.08	2.00	0.75	0.045	0.03	20.00	12.00			
01)	S.S. 304 SEAMLESS PIPE - 1" NB X SCH 40.	0.65	1.17	0.61	0.041	0.018	18.23	8.26			
	S.S. 304 SEAMLESS PIPE - 1-1/2" NB X SCH 40.	0.60	1.13	0.60	0.040	0.017	18.33	8.25			
	S.S. 304 SEAMLESS PIPE - 2" NB X SCH 40.	0.61	1.16	0.55	0.030	0.029	18.09	8.42			

Results: – Satisfactory.

REMARK: – The Above Material Satisfactorily Conforms To The requirement.
Material Confirm As Per S.S. 304.

NOTES: – We Here By Certify That The Material Described Here In Has Been Manufactured In Accordance With The Above Specification.

K.M. STEEL INDIA.

Production Executive / Manager.

Test Report End.

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MAKE IN INDIA

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	Stream-3	141	
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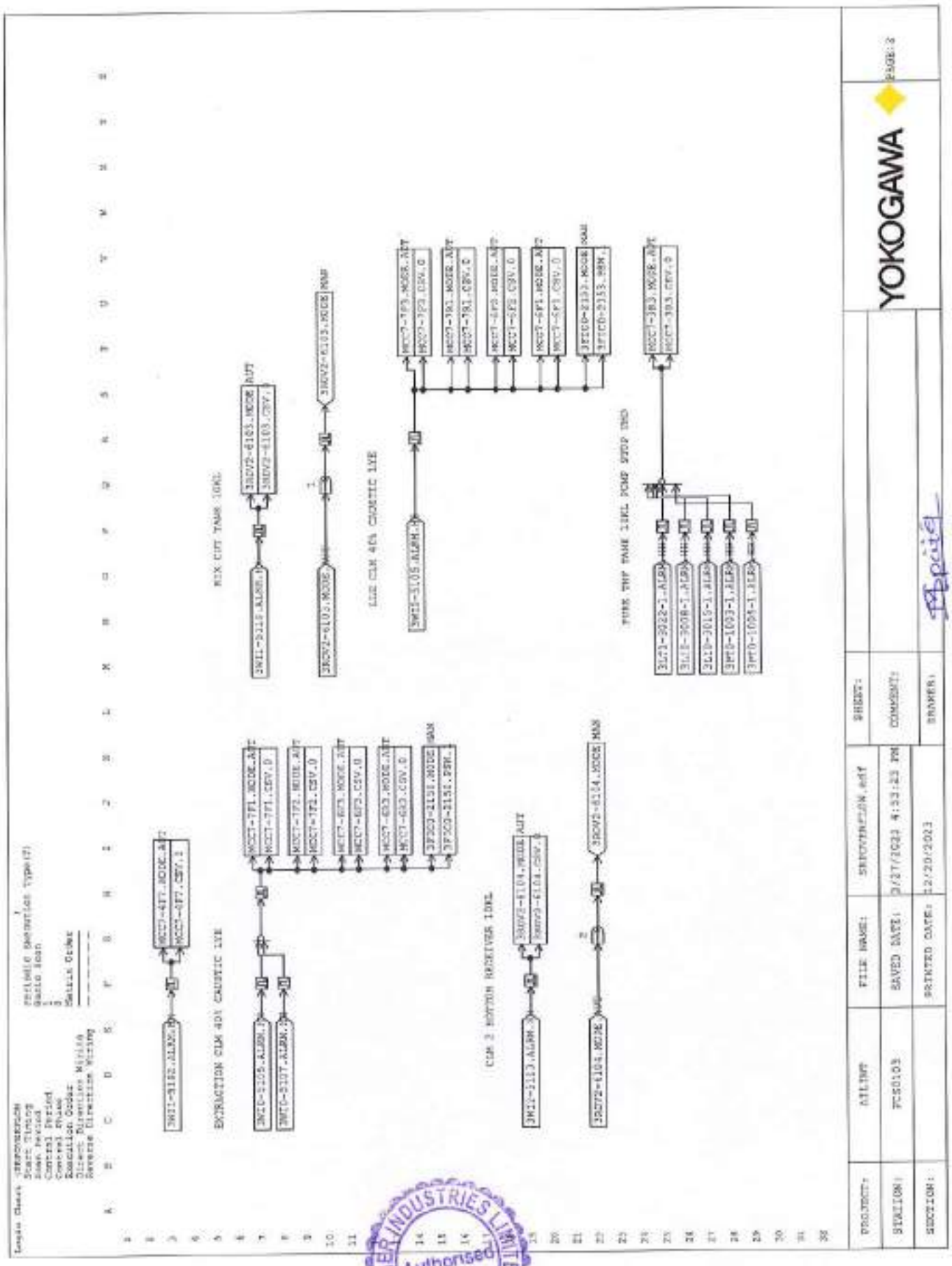
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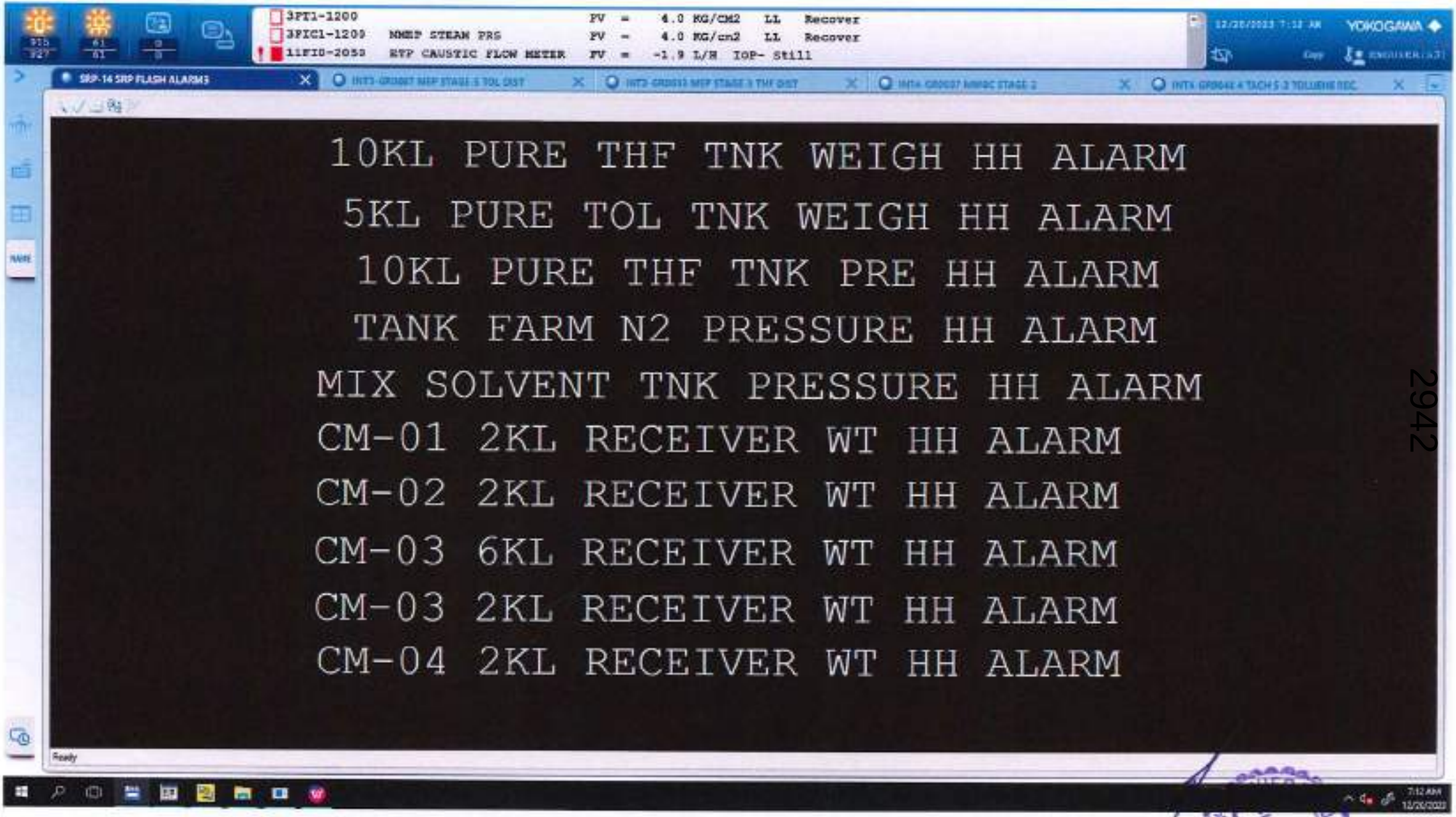
2940



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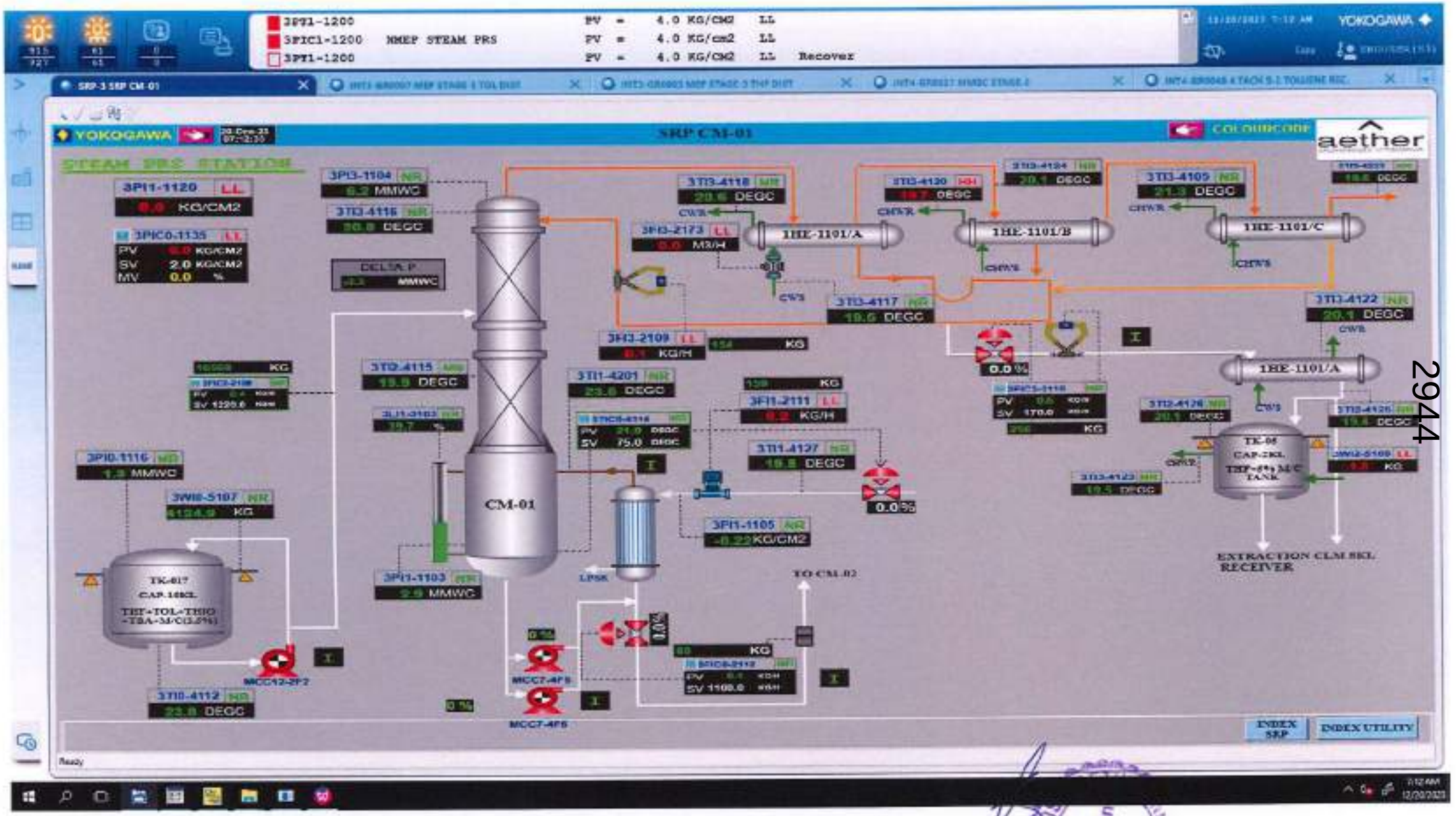

3PT1-1200 PV = 4.0 KG/CM2 LL Recover
3PIC1-1209 MMEP STEAM PRS PV = 4.0 KG/cn2 LL Recover
11FIS-2053 ETP CAUSTIC FLOW METER PV = -1.9 L/H IOP- Still
YOKOGAWA
SRP-14 SRP FLASH ALARM3
10KL PURE THF TNK WEIGH HH ALARM
5KL PURE TOL TNK WEIGH HH ALARM
10KL PURE THF TNK PRE HH ALARM
TANK FARM N2 PRESSURE HH ALARM
MIX SOLVENT TNK PRESSURE HH ALARM
CM-01 2KL RECEIVER WT HH ALARM
CM-02 2KL RECEIVER WT HH ALARM
CM-03 6KL RECEIVER WT HH ALARM
CM-03 2KL RECEIVER WT HH ALARM
CM-04 2KL RECEIVER WT HH ALARM
Ready

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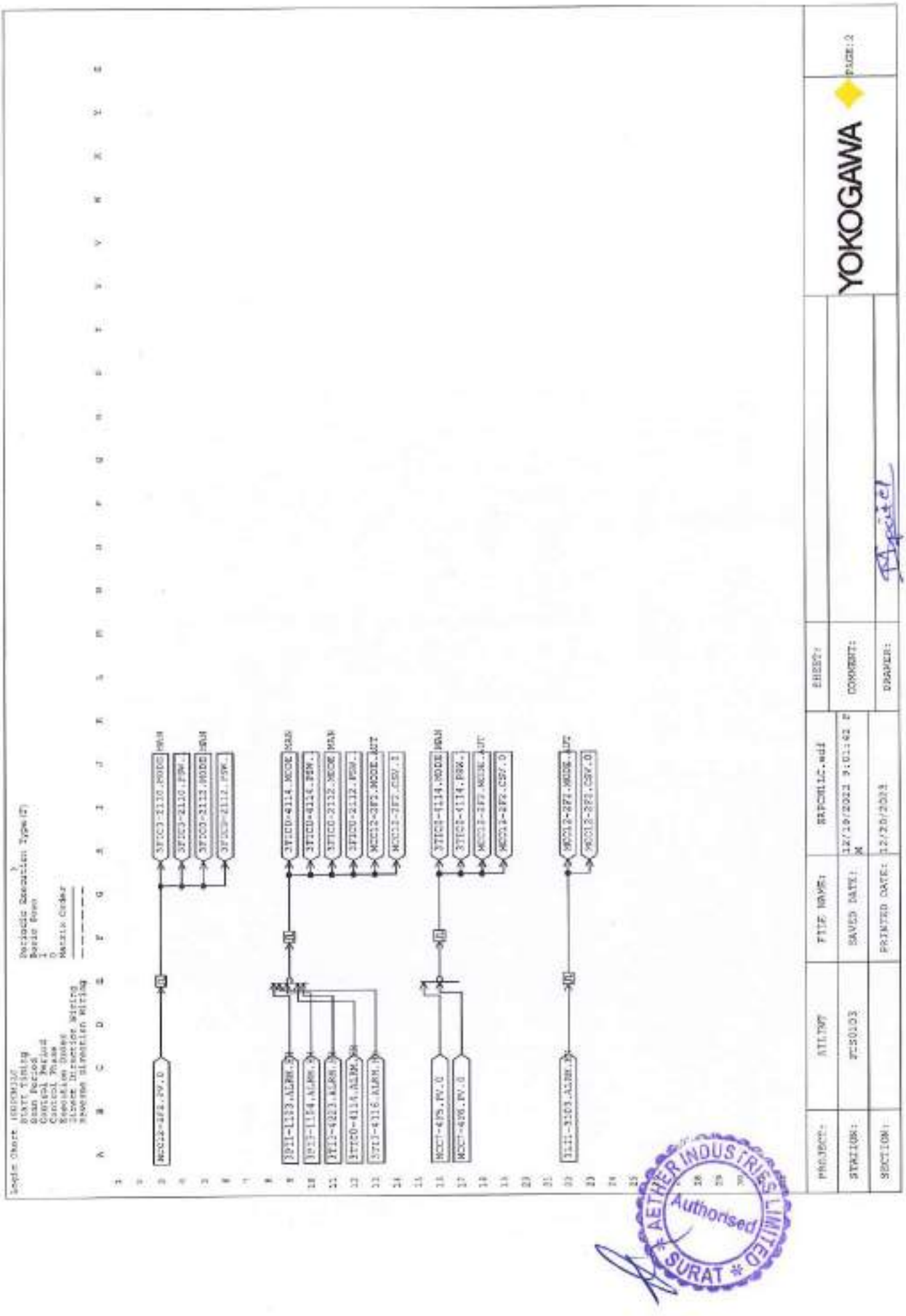

3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 MMEP STEAM PRS PV = 4.0 KG/cm2 LL
3PT1-1200 PV = 4.0 KG/CM2 LL Recover
YOKOGAWA
SRP CM-01
COLOURCODE
aether
STEAM SRS STATION
3PI1-1120 LL
KG/CM2
3PIC0-1135 LL
PV KG/CM2
SV 2.0 KG/CM2
MV 0.0 %
3PI3-1104 NR
MMWC
3TI3-4116 NR
DEGC
DELTA P
MMWC
3FI3-2173 LL
M3/H
3TI3-4118 NR
DEGC
3TI3-4120 HH
DEGC
3TI3-4124 NR
DEGC
3TI3-4105 NR
DEGC
1HE-1101/A
1HE-1101/B
1HE-1101/C
CWS
CWR
3TI3-4117 NR
DEGC
3TI3-4122 NR
DEGC
3FI3-2109 LL
KG/H
KG
0.0 %
3TI3-4115 NR
DEGC
3TI1-4201 NR
DEGC
3FI1-2111 LL
KG/H
3TI1-4127 NR
DEGC
0.0 %
3PI1-1105 NR
KG/CM2
CM-01
3PI1-1103 NR
MMWC
3PI0-1116 NR
MMWC
3WI0-5107 NR
KG
TK-01
CAP.2KL
TANK
EXTRACTION CLM SKL
RECEIVER
TO CM-02
MCC12-2F2
MCC7-4F5
MCC7-4F6
3TI0-4112 NR
DEGC
INDEX SRP
INDEX UTILITY
Ready

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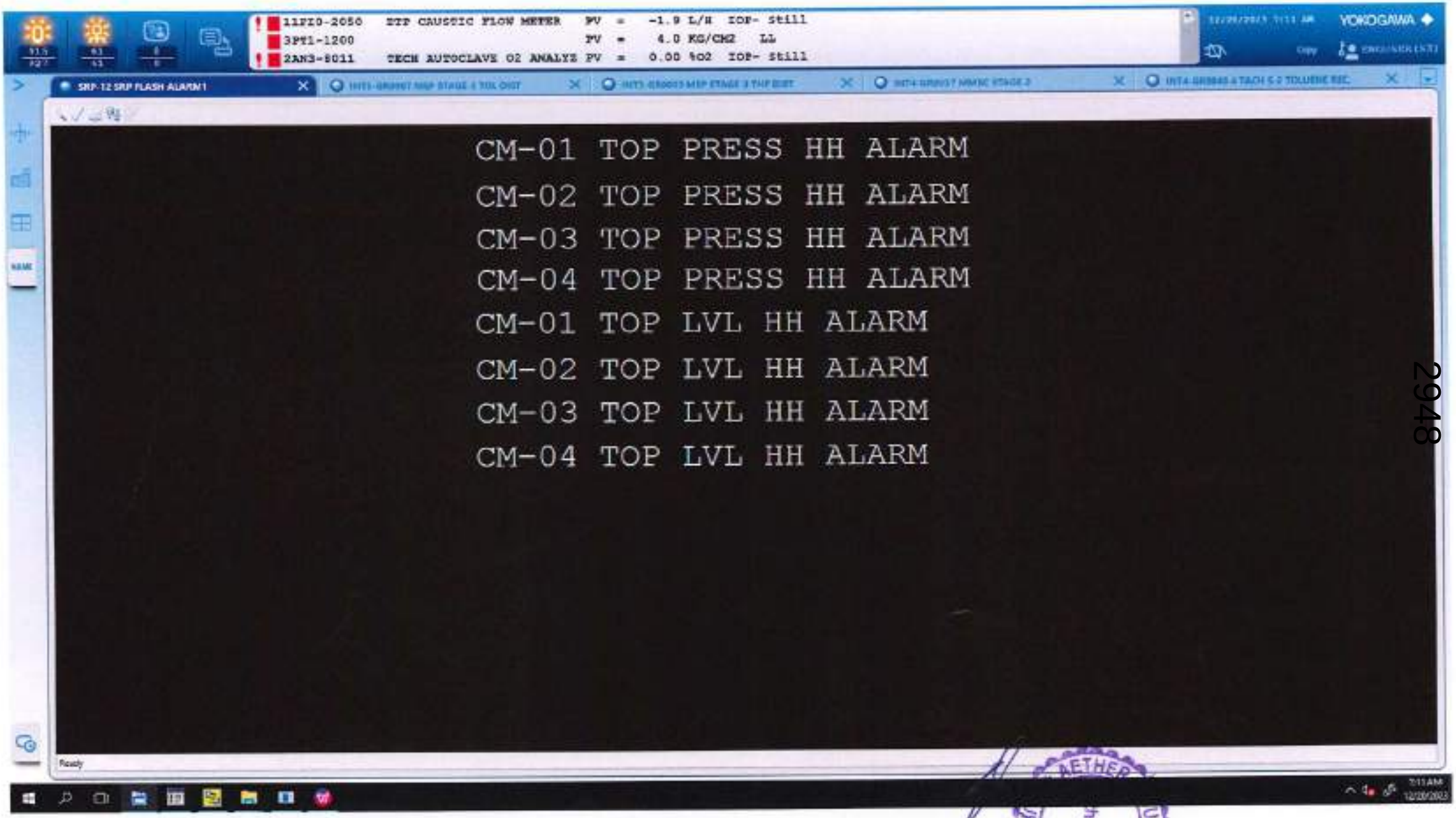
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Logic Chart (SEQUENCE)
Start Timing
Scan Period
Control Period
Control Phase
Execution Order
Close Connection Wiring
Open Connection Wiring
Periodic Execution Type(T)
Basic Even
1
0
Matrix Order
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STATION: FCS0103
SECTION:
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SAVED DATE: 12/19/2023 9:01:02 PM
PRINTED DATE: 12/20/2023
EDIT:
COMMENT:
DRAWER:
YOKOGAWA
PAGE:2
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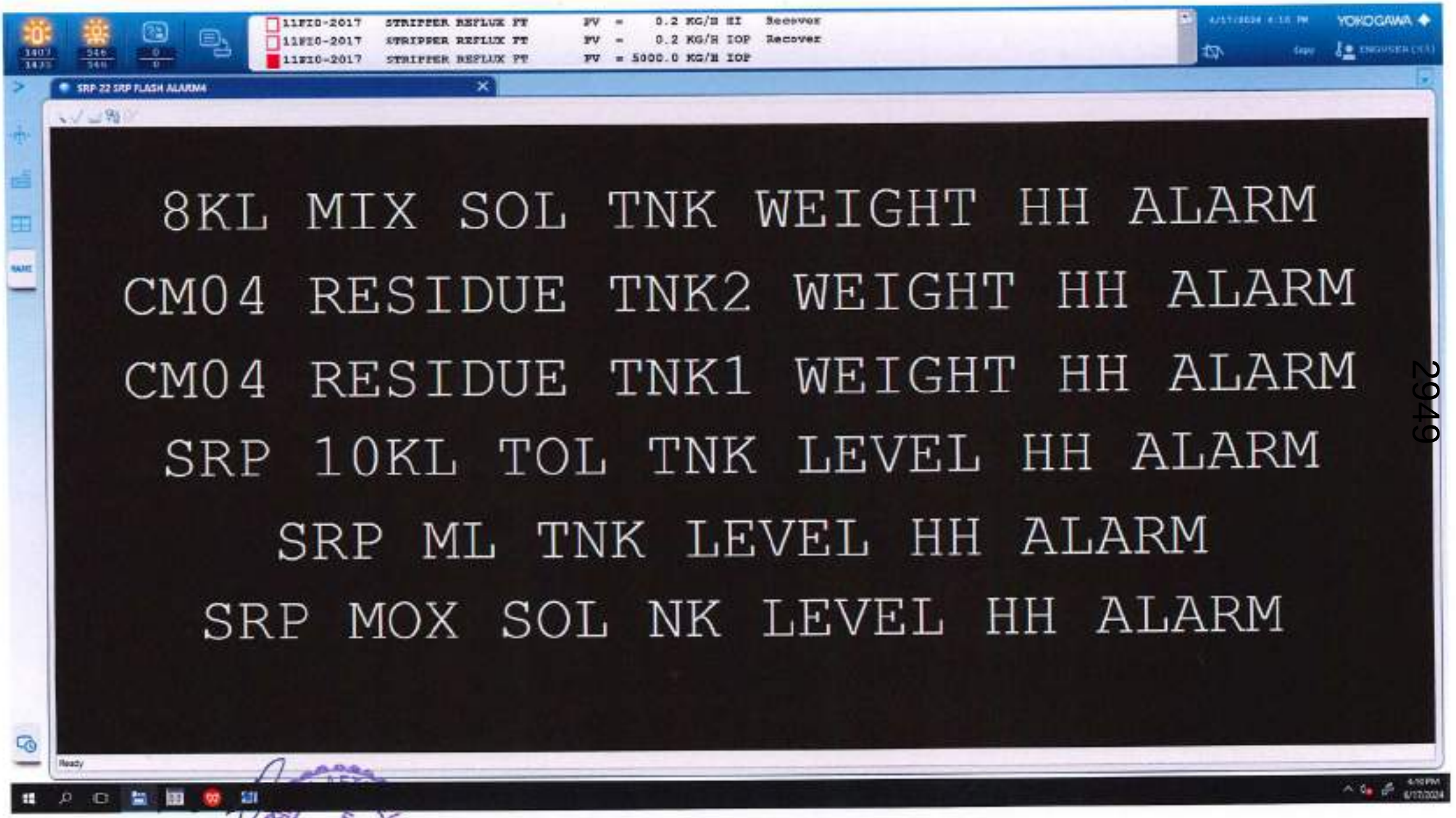
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	Stream-3	88	
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		90	
Node 4	Stream-1	123	
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Node 5	Stream-2	167	
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		189	
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11FI0-2050 ETP CAUSTIC FLOW METER PV = -1.9 L/H IOP- Still
3PT1-1200 PV = 4.0 KG/CM2 LL
2AN3-8011 TECH AUTOCLAVE O2 ANALYZ PV = 0.00 %O2 IOP- Still
YOKOGAWA
SRP-12 SRP FLASH ALARM1
CM-01 TOP PRESS HH ALARM
CM-02 TOP PRESS HH ALARM
CM-03 TOP PRESS HH ALARM
CM-04 TOP PRESS HH ALARM
CM-01 TOP LVL HH ALARM
CM-02 TOP LVL HH ALARM
CM-03 TOP LVL HH ALARM
CM-04 TOP LVL HH ALARM
Ready
7:11 AM

29948

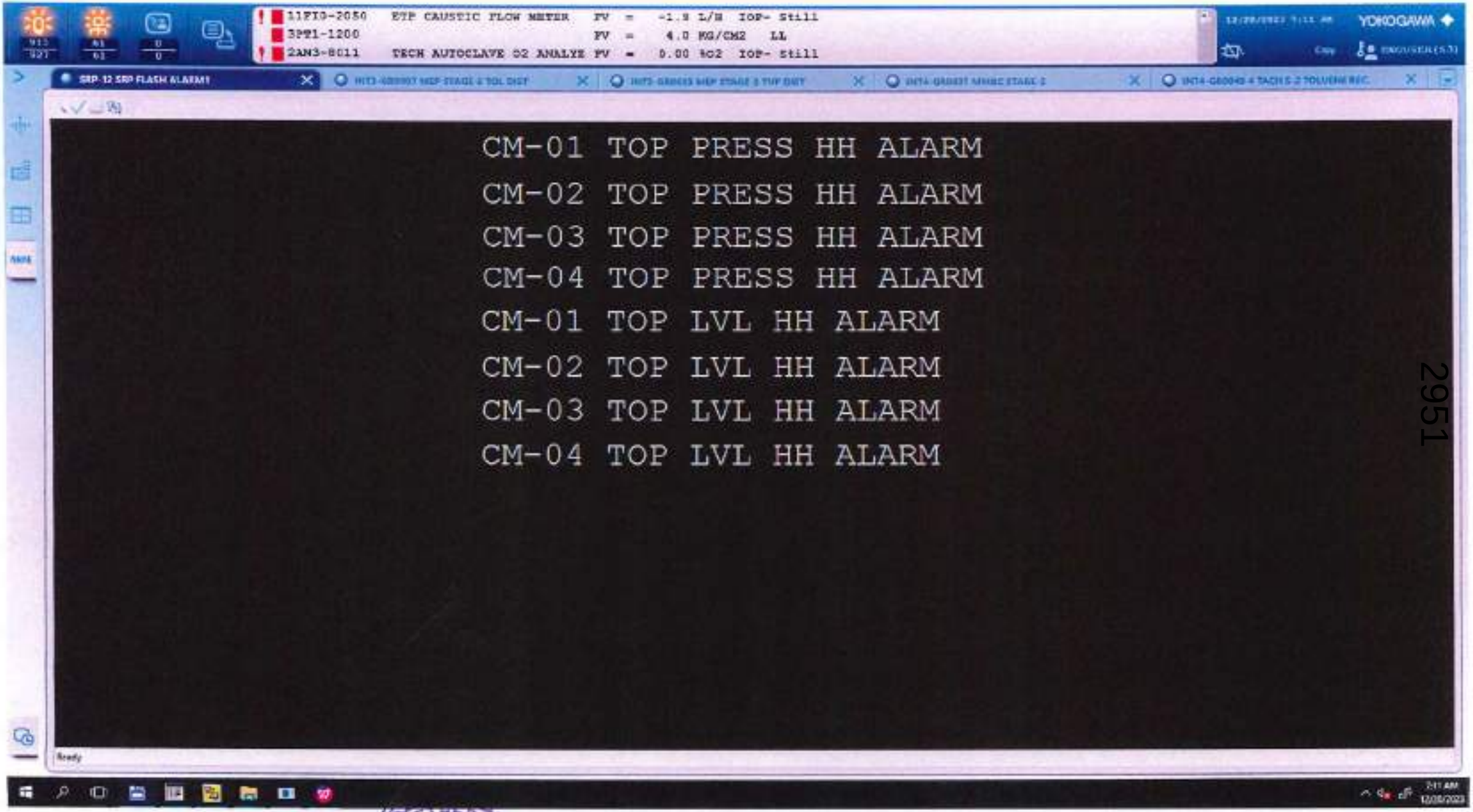

11FI0-2017 STRIPPER REFLUX FT PV = 0.2 KG/H EI Recover
11FI0-2017 STRIPPER REFLUX FT PV = 0.2 KG/H IOP Recover
11FI0-2017 STRIPPER REFLUX FT PV = 5000.0 KG/H IOP
YOKOGAWA
SRP 22 SRP FLASH ALARM4
8KL MIX SOL TNK WEIGHT HH ALARM
CM04 RESIDUE TNK2 WEIGHT HH ALARM
CM04 RESIDUE TNK1 WEIGHT HH ALARM
SRP 10KL TOL TNK LEVEL HH ALARM
SRP ML TNK LEVEL HH ALARM
SRP MOX SOL NK LEVEL HH ALARM
Ready

29949

Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-2	28	10
		30	
		35	
Node 3	Stream-2	76	
	Stream-3	92	
		93	
		96	
Node 4	Stream-2	126	
		131	
Node 5	Stream-1	164	

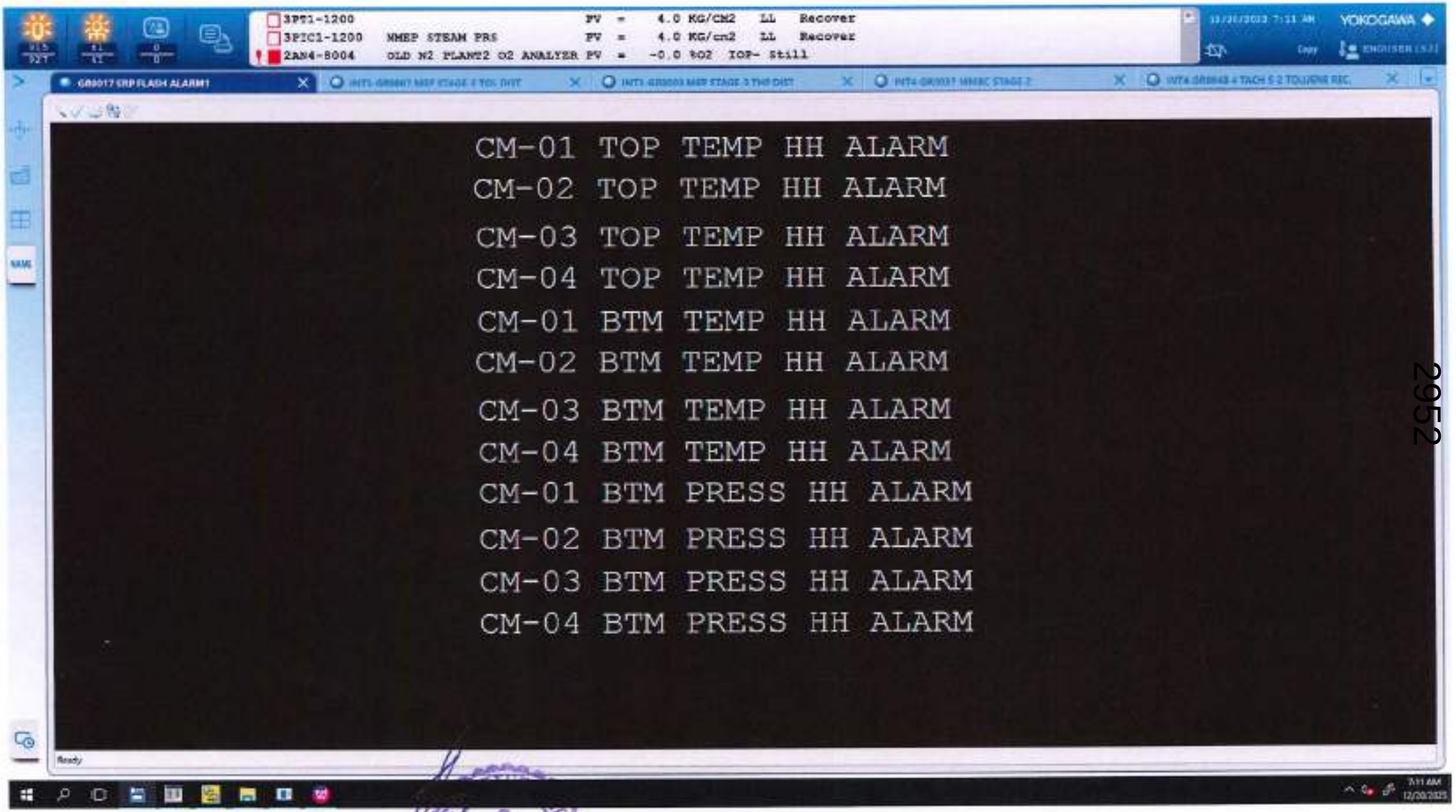
10



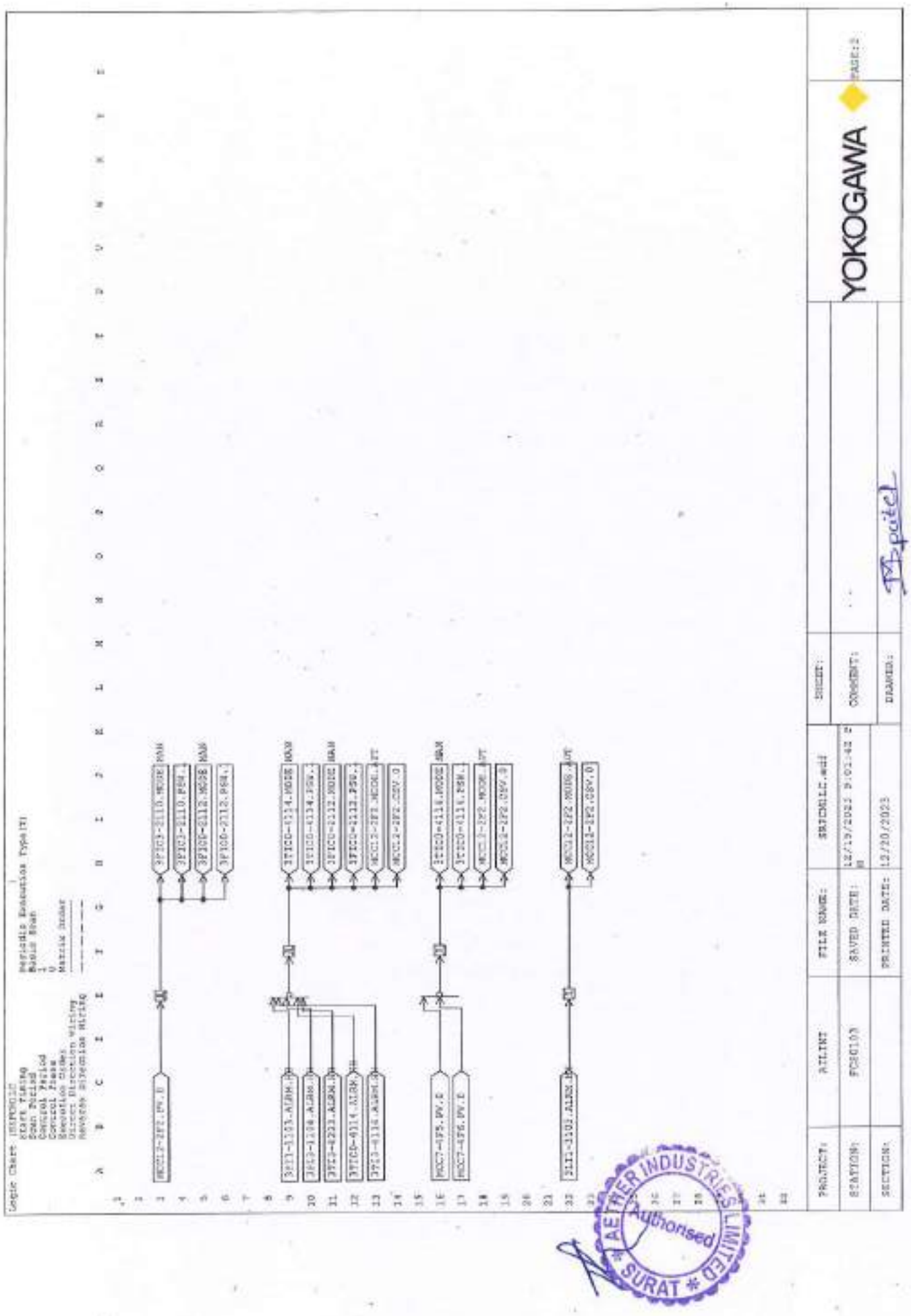


2951

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3PT1-1200 PV = 4.0 KG/CM2 LL Recover
3PIC1-1200 NMEP STEAM PRS PV = 4.0 KG/cm2 LL Recover
2AN4-8004 OLD N2 PLANT2 O2 ANALYZER PV = -0.0 %O2 IOP- Still
YOKOGAWA
GR017 SRP FLASH ALARM1
CM-01 TOP TEMP HH ALARM
CM-02 TOP TEMP HH ALARM
CM-03 TOP TEMP HH ALARM
CM-04 TOP TEMP HH ALARM
CM-01 BTM TEMP HH ALARM
CM-02 BTM TEMP HH ALARM
CM-03 BTM TEMP HH ALARM
CM-04 BTM TEMP HH ALARM
CM-01 BTM PRESS HH ALARM
CM-02 BTM PRESS HH ALARM
CM-03 BTM PRESS HH ALARM
CM-04 BTM PRESS HH ALARM
Ready

29952



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Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-2	34	11
		40	
Node 3		75	
Node 4		130	
		136	
Node 5		171	
		177	
		178	

11

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MONTHLY CONTROL VALVE STATUS CHECK SCHEDULE (2023-24)

SR NO.	PLANT NAME	TAG NO.	SERVICE	CONTROL VALVE OPENING STATUS FROM DCS				DATE	DONE BY	CHECK BY	REMARKS
				25%	50%	75%	100%				
1.	Plant-4	3TIC1-4276	THF Column Temp CV	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
2.	Plant-4	3TIC1-4367	T.F. Column Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
3.	Plant-4	3TIC1-4388	LAB Column Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
4.	Plant-4	3TIC1-4401	Stripper Column Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
5.	Plant-4	3TIC0-4429	Pure Distillation Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
6.	SRP	3TIC0-4114	Cont. Chm1 Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
7.	SRP	3PIC1-2115	Cont. Chm 2 Temp CV	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
8.	SRP	3TIC0-4143	Cont. Chm 3 Temp CV.	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-
9.	SRP	3TIC0-4158	Cont. Chm 4 Temp CV	ओपन	ओपन	ओपन	ओपन	18/12/2023	Mihir	ओपन	-

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Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-2	37	12
Node 3		78	
		81	
Node 4		133	
Node 5		174	

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Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-3	50	13

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Sign. & Date: 14/12/2023
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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT3-2110
Range	0 TO 2000 kg/h
Accuracy	± 0.5 %.
Calibration date	18/12/2023
Calibration due date	17/12/2023

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H |Xi-Xt|	% Error of F.S. |Xi-Xt| / F.S. *100
0	4.0	4.00	0	0	0.00
500	8.0	8.00	501	1	0.05
1000	12.0	12.02	1003	3	0.15
1500	16.0	16.06	1508	8	0.40
2000	20.0	20.07	2009	9	0.45

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Divyesh Parmar	Yasin Patel
Signature	Divyesh	

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Node	Stream	Sr. No.	Page Ref. No.
Node 1	Stream-2	15	14

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 17/12/2023 Equipment TAG No : TK-017 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	ok	✓	—	Jaimin
2	Check visual condition of flame element	checked	✓	—	Jaimin
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Jaimin
4	Visually check Gasket condition	ok	✓	—	Jaimin
Note:-					

Checked by MD

Checked By PD

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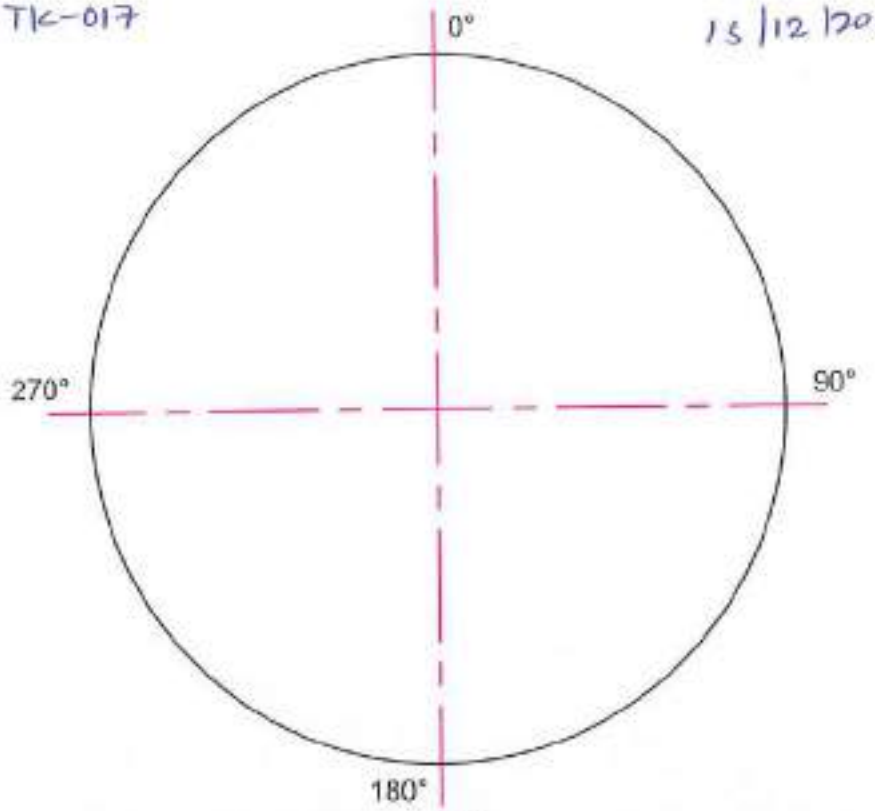
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Node 1	Stream-2	17	15

15

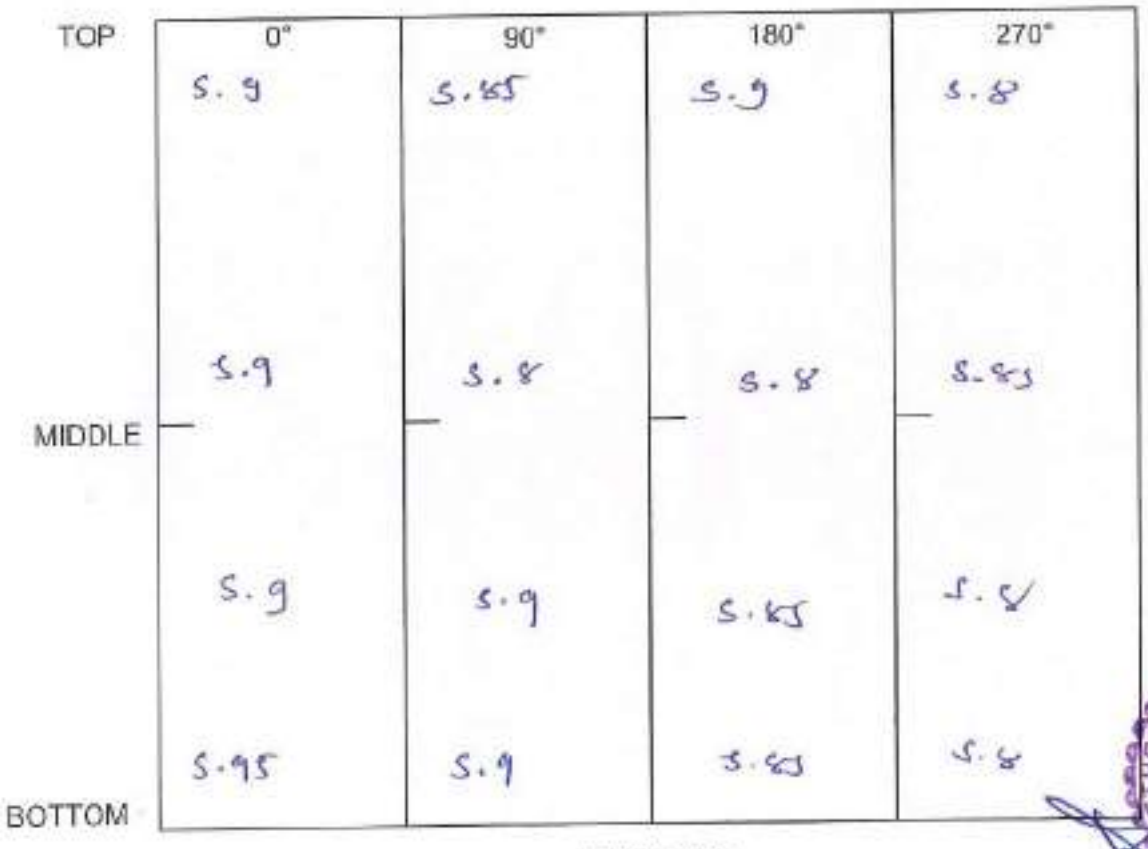
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TANK NO.- TK-017

15/12/2023



PLAN



ELEVATION

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Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-1	26	16

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 22/12/2023 Equipment ID No : TP-017 Block : INT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	alignment found ok	Piyush
2	Check visually foundation of the pump	OK	Piyush
3	Check frame bolting properly tight	tightning done	Piyush
4	Check the coupling condition	OK	Piyush
5	Check for any abnormal noise and vibrations.	NORMAL	Piyush
6	Check oil level in the bearing housing	oil top-up done	Piyush
7	Check spider condition	OK	Piyush
8	Check the coupling guard properly fitting	OK	Piyush
9	Check all nuts and bolts of pump for tightness	tightning done	Piyush
10	Check any leakages found from mechanical seal or gland	OK	Piyush

Checked by :

22/12/2023

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Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-2	31	17

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 20/12/2023 Equipment TAG No : CM-01 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓	—	Mukesh
2	Check visual condition of flame element	checked	✓	—	Mukesh
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Mukesh
4	Visually check Gasket condition	OK	✓	—	Mukesh
Note:-					

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Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-3	56	18

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 26/12/2023 Equipment TAG No : TK-05 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓		ASHISH
2	Check visual condition of flame element	ok	✓		ASHISH
3	Proper cleaning of flame element and Passage	Cleaned	✓		ASHISH
4	Visually check Gasket condition	Checked	✓		ASHISH

Note:-

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26/12/2023

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26/12/2023

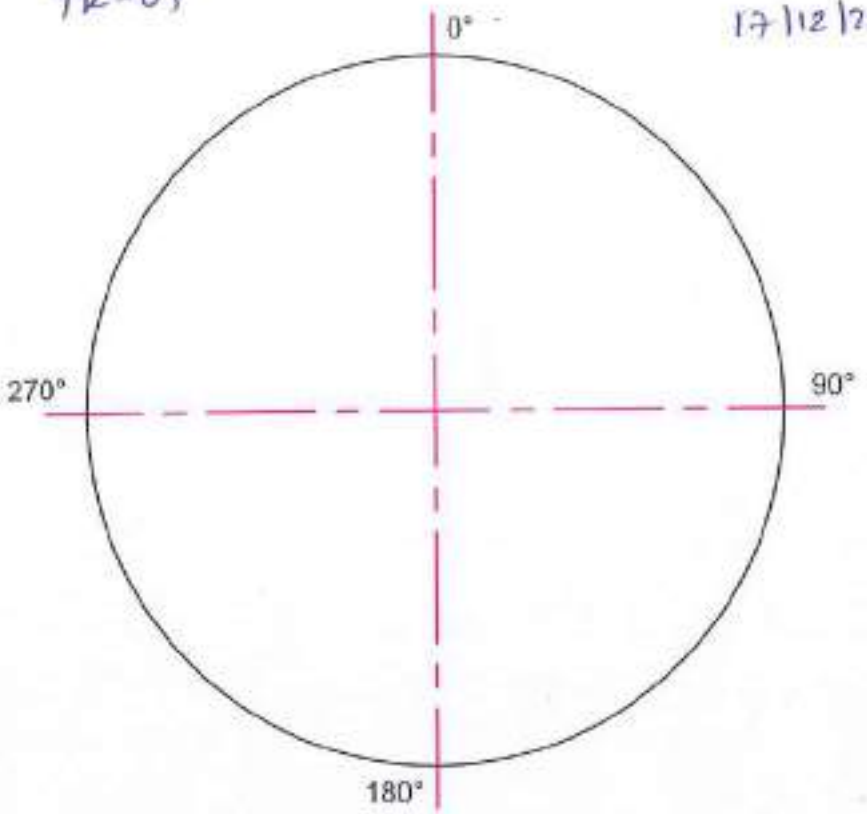
Node	Stream	Sr. No.	Page Ref. No.
Node 2	Stream-3	58	19

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TANK NO.- TK-05

17/12/2023



PLAN

	0°	90°	180°	270°
TOP	5.95	5.9	5.85	5.85
	5.9	5.95	5.8	5.85
MIDDLE	5.9	5.9	5.95	5.85
	5.85	5.8	5.85	5.8
BOTTOM	5.9	5.9	5.95	5.95

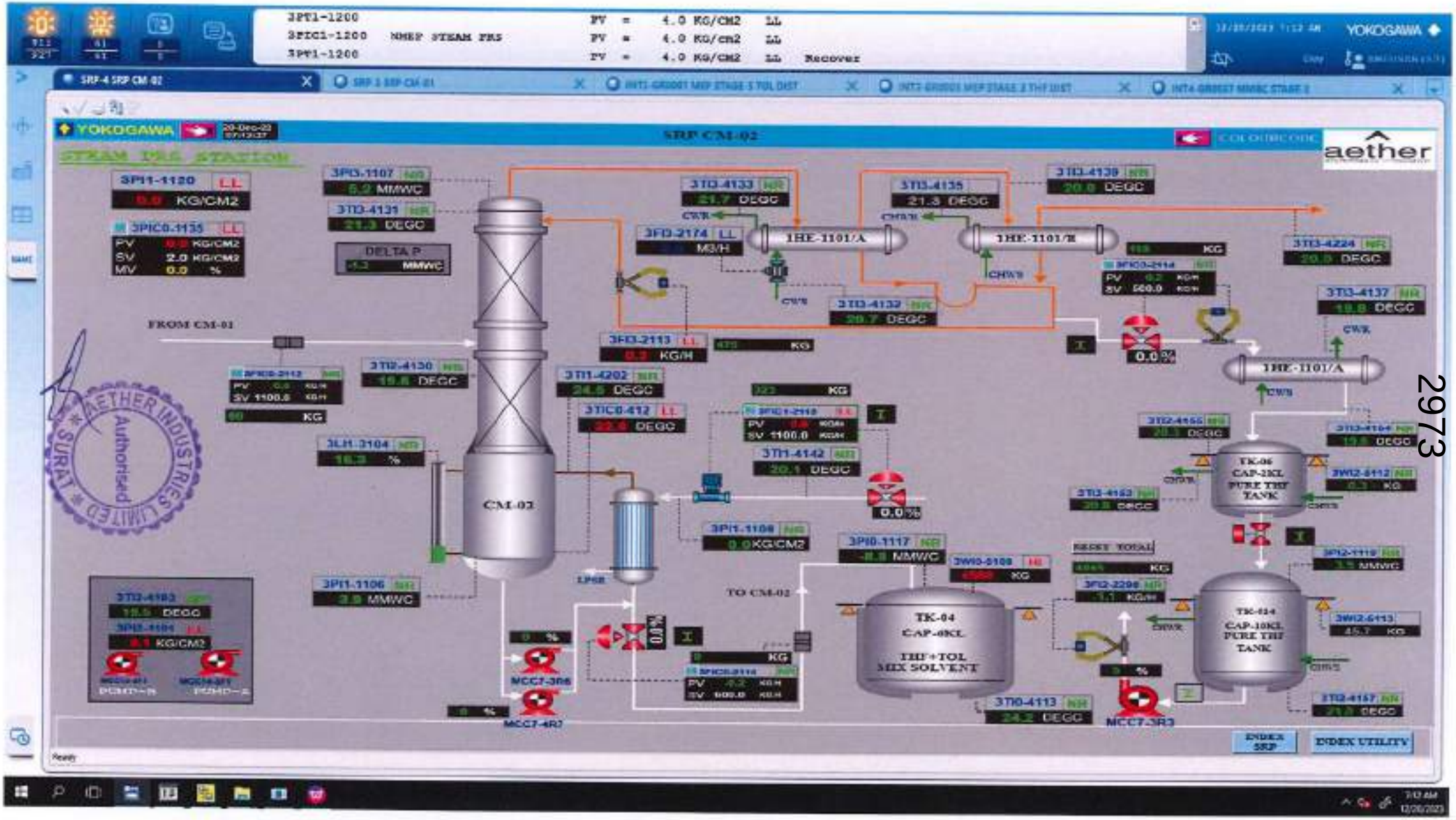
ELEVATION

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-1	60	20
Node 4	Stream-3	144	
		145	

20



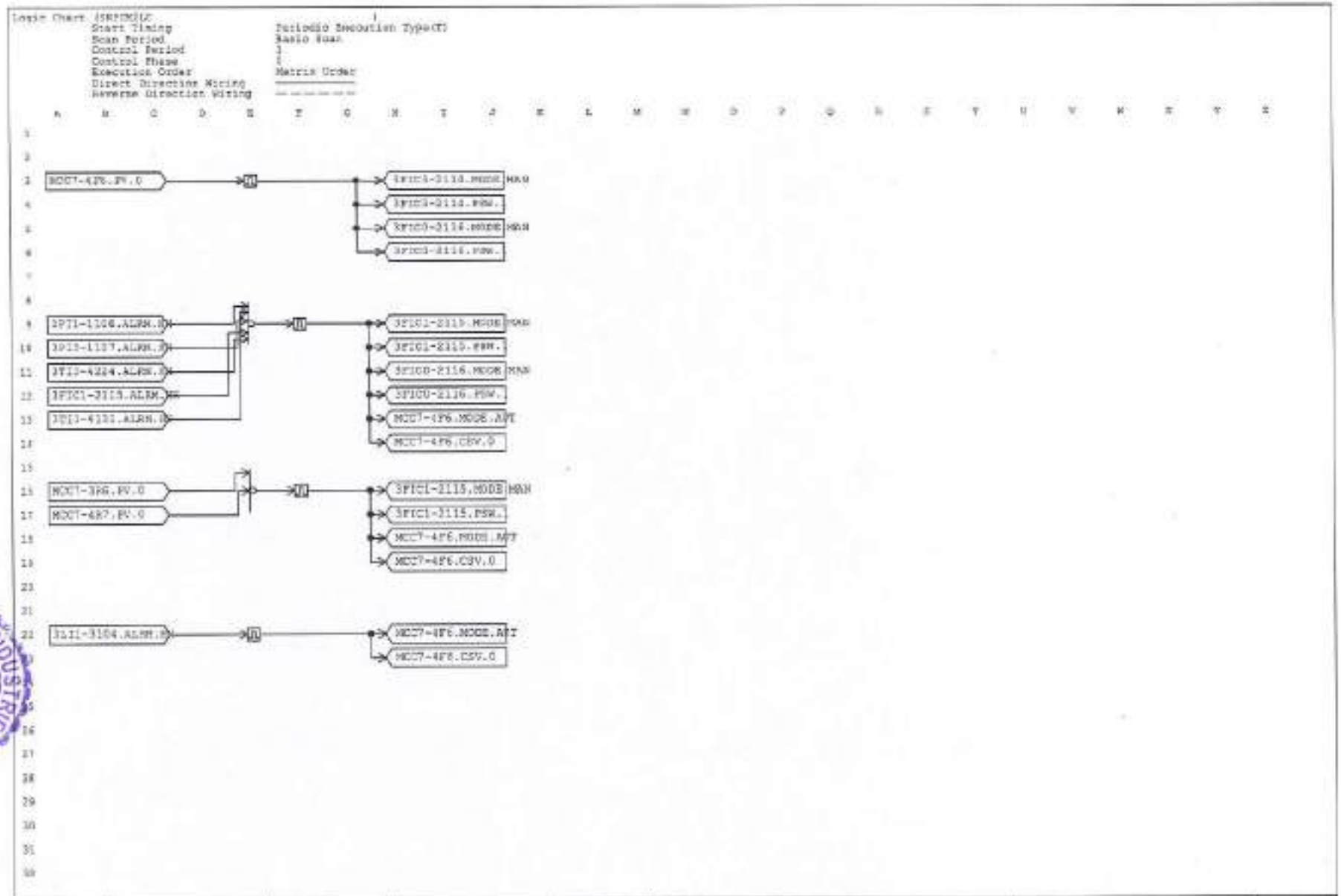


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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-1	61	21
		66	
	Stream-2	69	
	Stream-3	94	
	Stream-4	102	
		109	

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PROJECT:	AILINT	FILE NAME:	SRTCM21C.edf	SHEET:		YOKOGAWA	PAGE:2
STATION:	SCS0103	SAVED DATE:	12/19/2023 9:06:23 PM	COMMENT:			
SECTION:		PRINTED DATE:	12/20/2023	DRAWER:			

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-1	67	22

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 20/12/2023 Equipment ID No : CP-05 A Block : INT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	Alignment Checked OK	Sant
2	Check visually foundation of the pump	OK	Sant
3	Check frame bolting properly tight	All bolt Tighting	Sant
4	Check the coupling condition	Checkes found ok	Sant
5	Check for any abnormal noise and vibrations.	Checkes found ok	Sant
6	Check oil level in the bearing housing	oil level OK	Sant
7	Check spider condition	checkes found ok	Sant
8	Check the coupling guard properly fitting	OK	Sant
9	Check all nuts and bolts of pump for tightness	All nut bolt Tighting	Sant
10	Check any leakages found from mechanical seal or gland	Checkes found OK, No leakage	Sant

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20/12/2023

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 20/12/2023 Equipment ID No : CP-05B Block : INT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	Alignment Checked OK	Sant
2	Check visually foundation of the pump	OK	Sant
3	Check frame bolting properly tight	All bolt Tightning done	Sant
4	Check the coupling condition	OK	Sant
5	Check for any abnormal noise and vibrations.	Normal	Sant
6	Check oil level in the bearing housing	Oil level OK	Sant
7	Check spider condition	OK	Sant
8	Check the coupling guard properly fitting	OK	Sant
9	Check all nuts and bolts of pump for tightness	Tightning done	Sant
10	Check any leakages found from mechanical seal or gland	OK	Sant

Checked by :

20/12/2023

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-3	91	23

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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT3-2114
Range	0 TO 2000 kg/h
Accuracy	± 0.5 %
Calibration date	18/12/2023
Calibration due date	17/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H |Xi-Xt|	% Error of F.S. |Xi-Xt| / F.S. *100
0	4.0	4.00	0	0	0.00
500	8.0	8.02	503	3	0.15
1000	12.0	12.05	1007	7	0.35
1500	16.0	16.05	1507	7	0.35
2000	20.0	20.07	2009	9	0.45

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Divyesh Kumesh	Tejas Patel
Signature	Divyesh	

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-2	72	24

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 22/12/2023 Equipment TAG No : CM-02 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	ok	✓	—	Mukesh
2	Check visual condition of flame element	checked	✓	—	Mukesh
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Mukesh
4	Visually check Gasket condition	ok	✓	—	Mukesh
Note:-					

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-3	97	25

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 24/12/2023 Equipment TAG No : TK-06 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓	—	Mukesh
2	Check visual condition of flame element	checked	✓	—	Mukesh
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Mukesh
4	Visually check Gasket condition	OK	✓	—	Mukesh
Note:-					

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-4	108	26

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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FTO-2116
Range	0 TO 2000 kg/h
Accuracy	± 0.5 %
Calibration date	18/12/2023
Calibration due date	17/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (XI)	Absolute Error In L/H IXi-XtI	% Error of F.S. IXi-XtI / F.S. *100
00	4.0	4.00	00	0	0.00
500	8.0	8.04	505	5	0.25
1000	12.0	12.06	1008	8	0.40
1500	16.0	16.04	1506	6	0.30
2000	20.0	20.07	2009	9	0.45

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Divyesh Kumari	Jaimin Patel
Signature	Divyesh	

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Node	Stream	Sr. No.	Page Ref. No.
Node 3	Stream-4	111	27

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 25/12/2023 Equipment TAG No : TK-04 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓	—	Dipak
2	Check visual condition of flame element	checked	✓	—	Dipak
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Dipak
4	Visually check Gasket condition	OK	✓	—	Dipak
Note:-					

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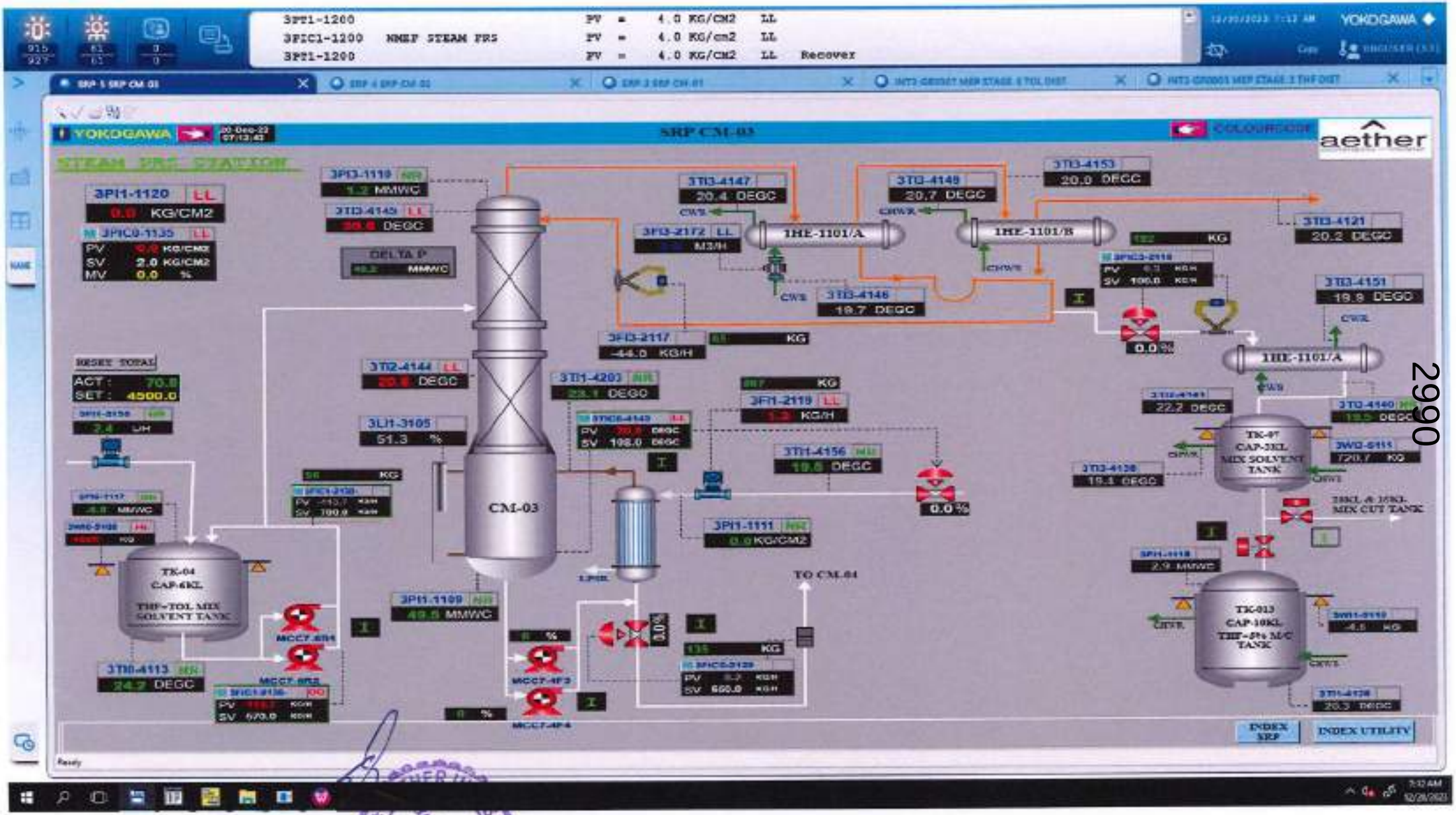
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Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-1	115	28

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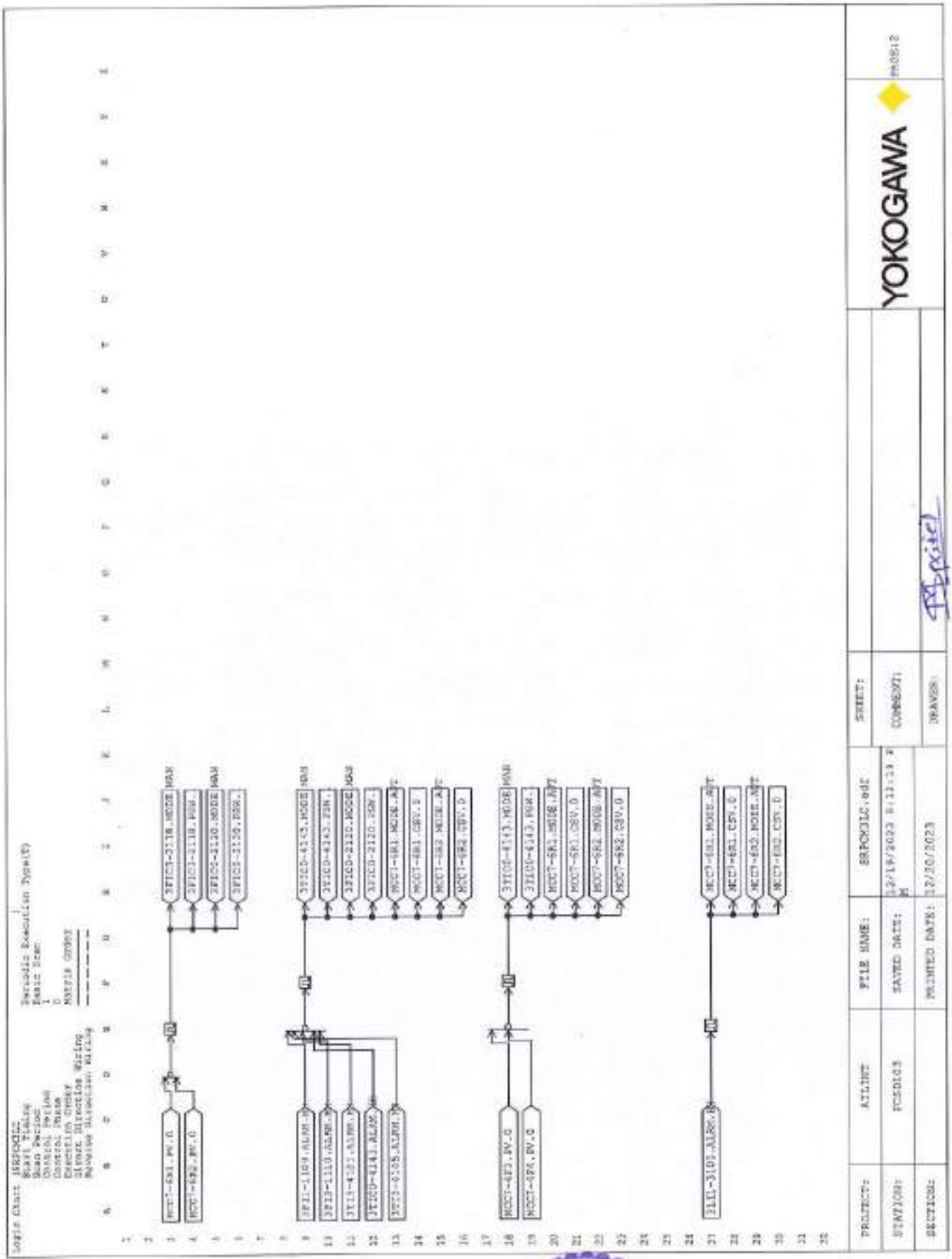

3PT1-1200 PV = 4.0 KG/CM2 LL
3PIC1-1200 NMEF STEAM PRS PV = 4.0 KG/cm2 LL
3PT1-1200 PV = 4.0 KG/CM2 LL Recover
YOKOGAWA
SRP CM-03
aether
STEAM PRS STATION
3PI1-1120 LL
0.0 KG/CM2
3PIC0-1135 LL
PV 0.0 KG/CM2
SV 2.0 KG/CM2
MV 0.0 %
3PI3-1119
1.2 MMWC
3TI3-4149 LL
DELTA P
3TI3-4147
20.4 DEGC
3FI3-2172 LL
M3/H
1HE-1101/A
3TI3-4148
19.7 DEGC
1HE-1101/B
3TI3-4153
20.0 DEGC
3TI3-4121
20.2 DEGC
3TI3-4151
19.8 DEGC
3FI3-2117
-46.0 KG/H
3TI2-4144 LL
3TI1-4203
3FI1-2119 LL
KG/H
3LI1-3105
51.3 %
CM-03
3TI1-4156
19.8 DEGC
0.0 %
3PI1-1111
0.0 KG/CM2
3PI1-1109
49.5 MMWC
TO CM-04
TK-04
CAP-6KL
THF+TOL MIX
SOLVENT TANK
3TI3-4113
24.7 DEGC
MCC7-4P1
MCC7-4P2
MCC7-4P3
MCC7-4P4
TK-07
CAP-3KL
MIX SOLVENT
TANK
3TI3-4140
3WI3-5111
720.7 KG
3TI3-4138
19.1 DEGC
3KL & 10KL
MIX CUT TANK
TK-013
CAP-10KL
THF+5% M/C
TANK
3TI1-4128
20.3 DEGC
INDEX SRP
INDEX UTILITY
Ready

2990

Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-1	116	29
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Logic Chart JSRPCH02
Periodic Execution System
Start Timing
Scan Period
Control Period
Control Phase
Execution Order
Signal Direction Wiring
Revision Direction Wiring
Basic Scan
1
0
Matrix order
YOKOGAWA
PROJECT:
STATION:
SECTION:
ATLINE
PCSD103
FILE NAME:
SAVED DATE:
PRINTED DATE:
SRPCH02.edf
12/20/2023
SHEET:
COMMENT:
DRAWER:


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Logic Chart (SRPCVLC)

Start Timing: Periodic Execution Type(P)
Scan Period: Basic Scan
Control Period: 1
Control Phase: 0
Execution Order: Matrix Order
Direct Direction Wiring
Reverse Direction Wiring

CONTINUOUS COLDMH LOGIC

SRP CM-1



SRP CM-2



SRP CM-3



SRP CM-4



PROJECT:	AILINT	FILE NAME:	SRPCVLC.edf	SHEET:		YOKOGAWA
STATION:	FCS0103	SAVED DATE:	12/9/2022 5:13:52 PM	COMMENT:		PAGE:1
SECTION:		PRINTED DATE:	6/17/2024	DRAWER:		

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2993

Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-1	122	30

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 23/12/2023 Equipment ID No : TP-012 Block : INT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	Alignment checked OK	Sant
2	Check visually foundation of the pump	OK	Sant
3	Check frame bolting properly tight	All bolt tighting	Sant
4	Check the coupling condition	Checked Found OK	Sant
5	Check for any abnormal noise and vibrations.	Checked Found OK	Sant
6	Check oil level in the bearing housing	oil level OK	Sant
7	Check spider condition	Checked Found OK	Sant
8	Check the coupling guard properly fitting	OK	Sant
9	Check all nuts and bolts of pump for tightness	All bolt Tighting	Sant
10	Check any leakages found from mechanical seal or gland	Checked Found OK, No leakage	Sant

Checked by :

23/12/2023

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Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-2	127	31

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 26/12/2023 Equipment TAG No : CM-03 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	ok	✓	—	Piyush
2	Check visual condition of flame element	checked	✓	—	Piyush
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Piyush
4	Visually check Gasket condition	ok	✓	—	Piyush
Note:-					

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-3	146	32

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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT3-2118
Range	0 TO 1000 kg/h
Accuracy	± 0.5%
Calibration date	18/12/2023
Calibration due date	17/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H IXi-XtI	% Error of F.S. IXi-XtI / F.S. *100
0	4.0	4.00	0	0	0.0
250	8.0	8.01	251	1	0.1
500	12.0	12.04	503	3	0.3
750	16.0	16.06	754	4	0.4
1000	20.0	20.06	1004	4	0.4

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Divyesh Kumari	Jasim Ansari
Signature	Divyesh	

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Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-3	152	33

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 27/12/2023 Equipment TAG No : TK-07 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓	—	Jaimin
2	Check visual condition of flame element	checked	✓	—	Jaimin
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Jaimin
4	Visually check Gasket condition	OK	✓	—	Jaimin
Note:-					

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No.
Node 4	Stream-3	154	34

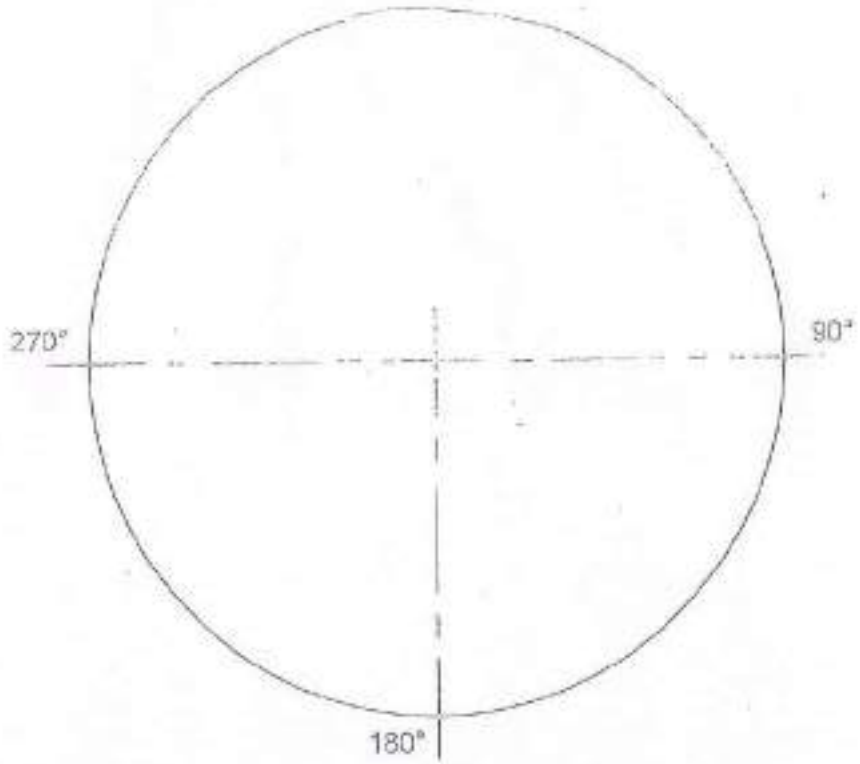
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15/12/2023

TK-07

3003



PLAN

	0°	90°	180°	270°
TOP	5.8	5.7	5.8	5.7
MIDDLE	5.9	5.8	5.8	5.7
BOTTOM	5.7	5.9	5.8	5.9

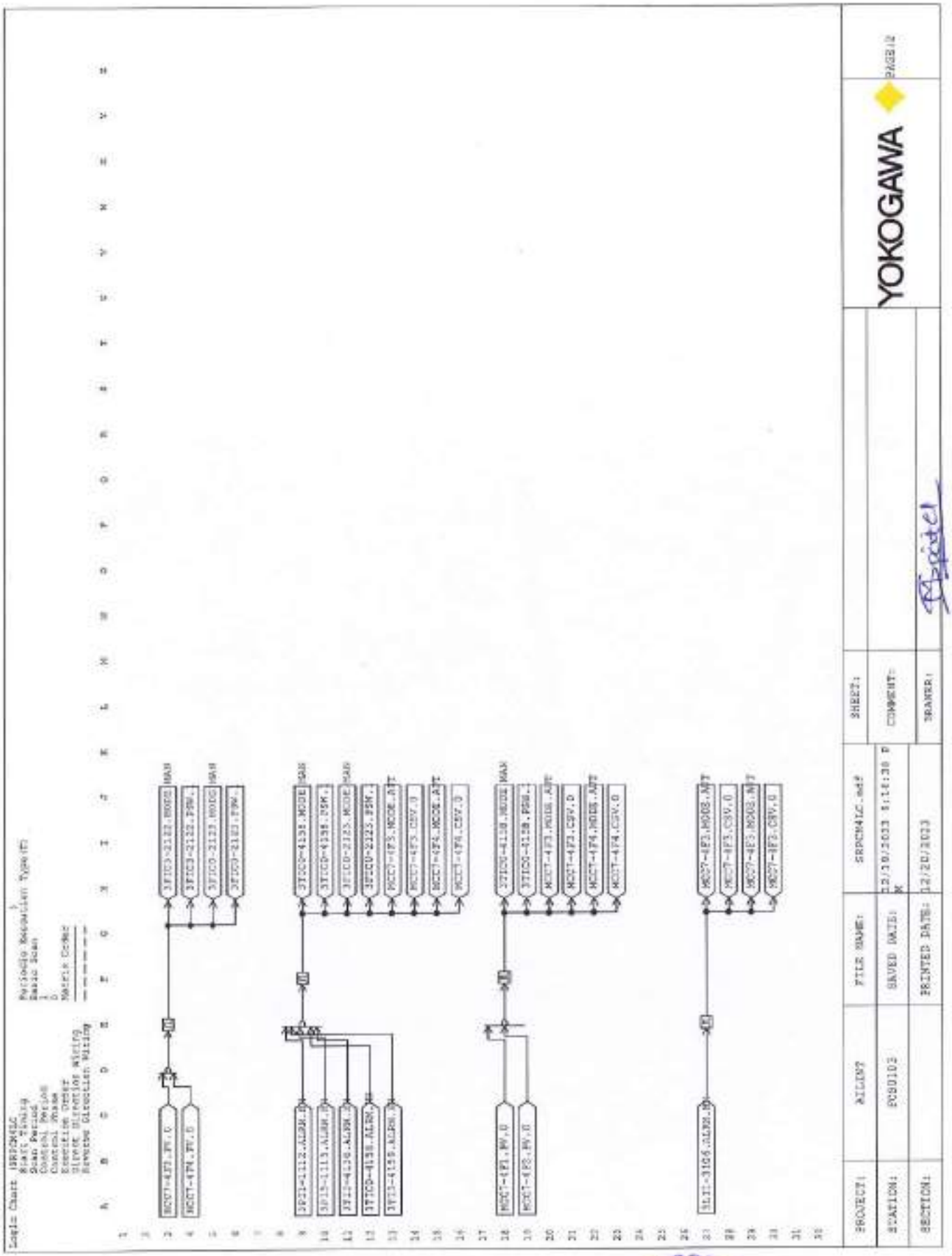
ELEVATION

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 24/12/2023 Equipment ID No : CP-07 A Block : INT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	Alignment checked OK	Ajay
2	Check visually foundation of the pump	OK	Ajay
3	Check frame bolting properly tight	All bolt tighting	Ajay
4	Check the coupling condition	Checked Found OK	Ajay
5	Check for any abnormal noise and vibrations.	Checked Found OK	Ajay
6	Check oil level in the bearing housing	oil level OK	Ajay
7	Check spider condition	Checked Found OK	Ajay
8	Check the coupling guard properly fitting	OK	Ajay
9	Check all nuts and bolts of pump for tightness	All bolt Tighting	Ajay
10	Check any leakages found from mechanical seal or gland	Checked Found OK, No leakage	Ajay

Checked by :

24/12/2023

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PREVENTIVE MAINTENANCE OF PUMP (MONTHLY)

PREVENTIVE MAINTENANCE CHECKLIST FOR PUMP		Date : 24/12/2023 Equipment ID No : CP-07B Block : INT-04	
S.No	Description	Remarks	Performed by
1	Check visually alignment of the pump & motor	Alignment checked OK	Piyush
2	Check visually foundation of the pump	OK	Piyush
3	Check frame bolting properly tight	All bolt Tighting	Piyush
4	Check the coupling condition	Checked Found OK	Piyush
5	Check for any abnormal noise and vibrations.	Checked Found ok	Piyush
6	Check oil level in the bearing housing	oil level OK	Piyush
7	Check spider condition	Checked Found OK	Piyush
8	Check the coupling guard properly fitting	OK	Piyush
9	Check all nuts and bolts of pump for tightness	All bolt Tighting	Piyush
10	Check any leakages found from mechanical seal or gland	Checked Found OK, No leakage	Piyush

Checked by :

24/12/2023

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 28/12/2023 Equipment TAG No : CM-04 Block : IN1-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	OK	✓	—	Sant
2	Check visual condition of flame element	checked	✓	—	Sant
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaned	✓	—	Sant
4	Visually check Gasket condition	OK	✓	—	Sant

Note:-

Checked by MD

Checked By PD

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Node	Stream	Sr. No.	Page Ref. No.
Node 5	Stream-3	187	38

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Sign. & Date: 19/12/2023
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FLOW TRANSMITTER CALIBRATION RECORD SHEET

Flow Transmitter	
I.D number	3FT3-2122
Range	0 TO 3000 kg/h
Accuracy	± 0.5 %
Calibration date	18/12/2023
Calibration due date	17/12/2024

Result of Calibration

Set Point On Digital Flow Meter L/H	Corresponding mA =[(Xt*16)/Span of UUC]+4	mA Observed by Universal Calibrator attached UUC	Corresponding reading in L/H (UUC) (Xi)	Absolute Error in L/H |Xi-Xt|	% Error of F.S. |Xi-Xt| / F.S. *100
0	4.0	4.00	0	0	0.00
750	8.0	8.04	759	9	0.30
1500	12.0	12.06	1512	12	0.40
2250	16.0	16.06	2260	10	0.33
3000	20.0	20.06	3013	13	0.33

Remarks (If Any)

DESCRIPTION	WORK DONE BY	APPROVED BY
Name	Dixresh Kamed	Yesim Patel
Signature	Dixresh	

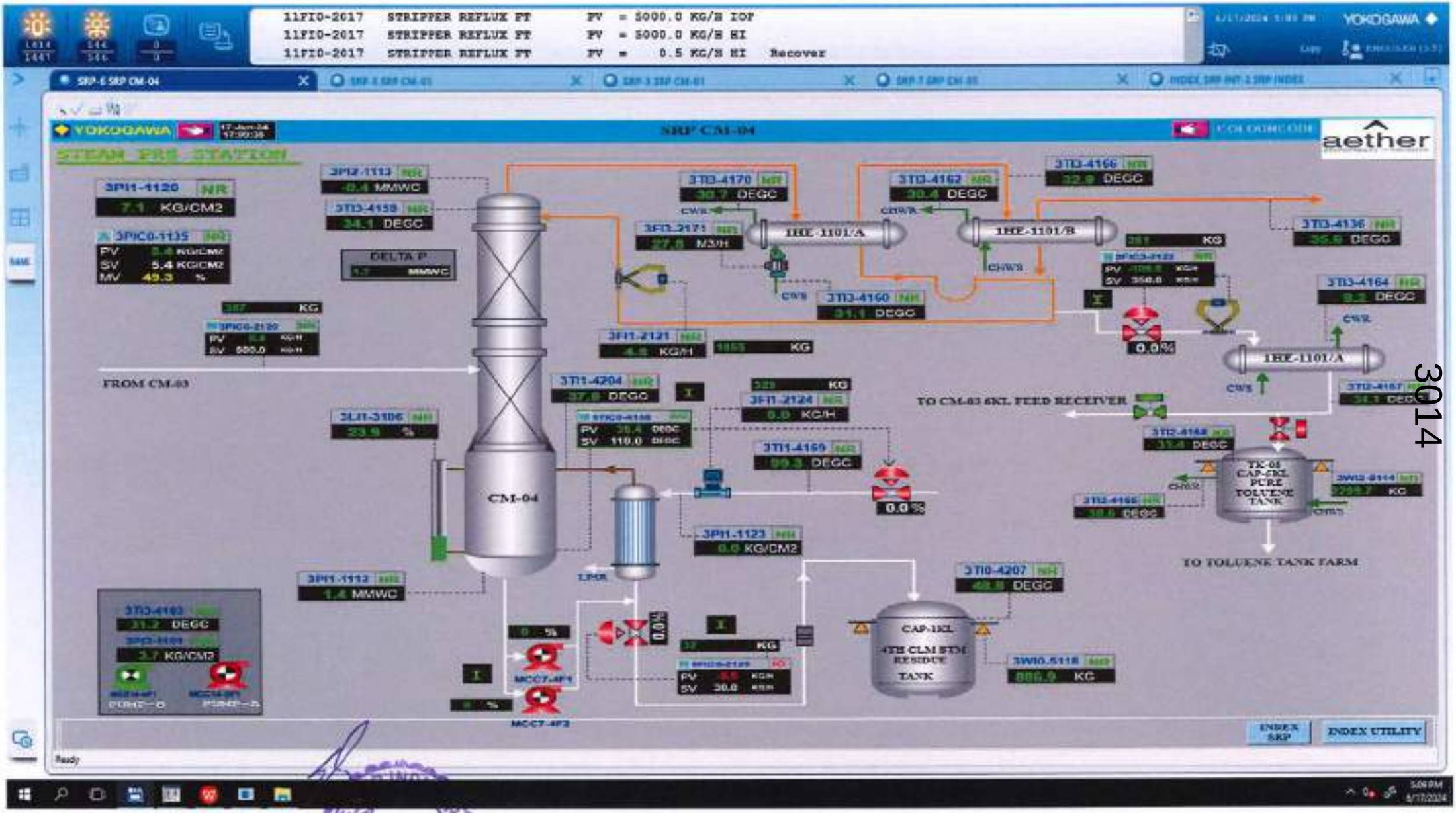
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Node	Stream	Sr. No.	Page Ref. No.
Node 5	Stream-3	193	40

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PREVENTIVE MAINTENANCE OF FLAME ARRESTER

PREVENTIVE MAINTENANCE CHECKLIST FOR FLAME ARRESTER (QURTERLY or HALF YEARLY)		Date : 29/12/2023 Equipment TAG No : TK-08 Block : INT-04			
S.No	Description	Remark	QURTERLY	HALF YEARLY	Performed by
1	Check All nuts and bolts for tightness	Done	✓	—	Dipak
2	Check visual condition of flame element	checked	✓	—	Dipak
3	Proper cleaning of flame element and Passage (With Nitrogen)	cleaning Done	✓	—	Dipak
4	Visually check Gasket condition	checked, ok	✓	—	Dipak
Note:-					

Checked by MD

Checked By PD

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3017

HAZOP STUDY REPORT OF

2CE-CEE (PLANT-1)

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

MAY 2024

aether
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NEXA
Process Safety Engineers

3018

AETHER INDUSTRIES LTD.,

SURAT

HAZOP STUDY REPORT OF

2CE-CEE (PLANT-1)

MAY 2024

By

NEXA PROCESS SAFETY ENGINEERS

ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel, Mr. Smit Desai and respective representatives of other departments involved in HAZOP study.

Surat NEXA PROCESS SAFETY ENGINEERS SURAT **Proprietor**

05/05/2024 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation
- To identify significant operating or quality problems
- To identify practical problems associated with maintenance operation

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for 2CE-CEE product.

Nexa Process Safety Engineers deputed Mr. S. G. Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management.

The participants had a significant amount of experience in the Process Safety Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well-known as well as the required control measures to reduce risk to acceptable levels.

During the study Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 SCOPE

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for 2CE-CEE product of Plant 1. It has 8 nodes as per following:

NODE NO.	NODE DESCRIPTION
1.	EO INT TANK(013TK-127A/B)
2.	EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)
3.	2CE absorption mass storage tank(011ST-035/011ST-036)
4.	011CM-018 (Continuous Distillation Column)
5.	021CM-066 (Continuous Distillation Column)
6.	CEE pure distillation reactor(011RT-042)
7.	2CE distillation reactor(011RT-158)
8.	2CE distillation reactor(021RT-155)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 METHODOLOGY

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing

safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel, examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.

7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.
10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

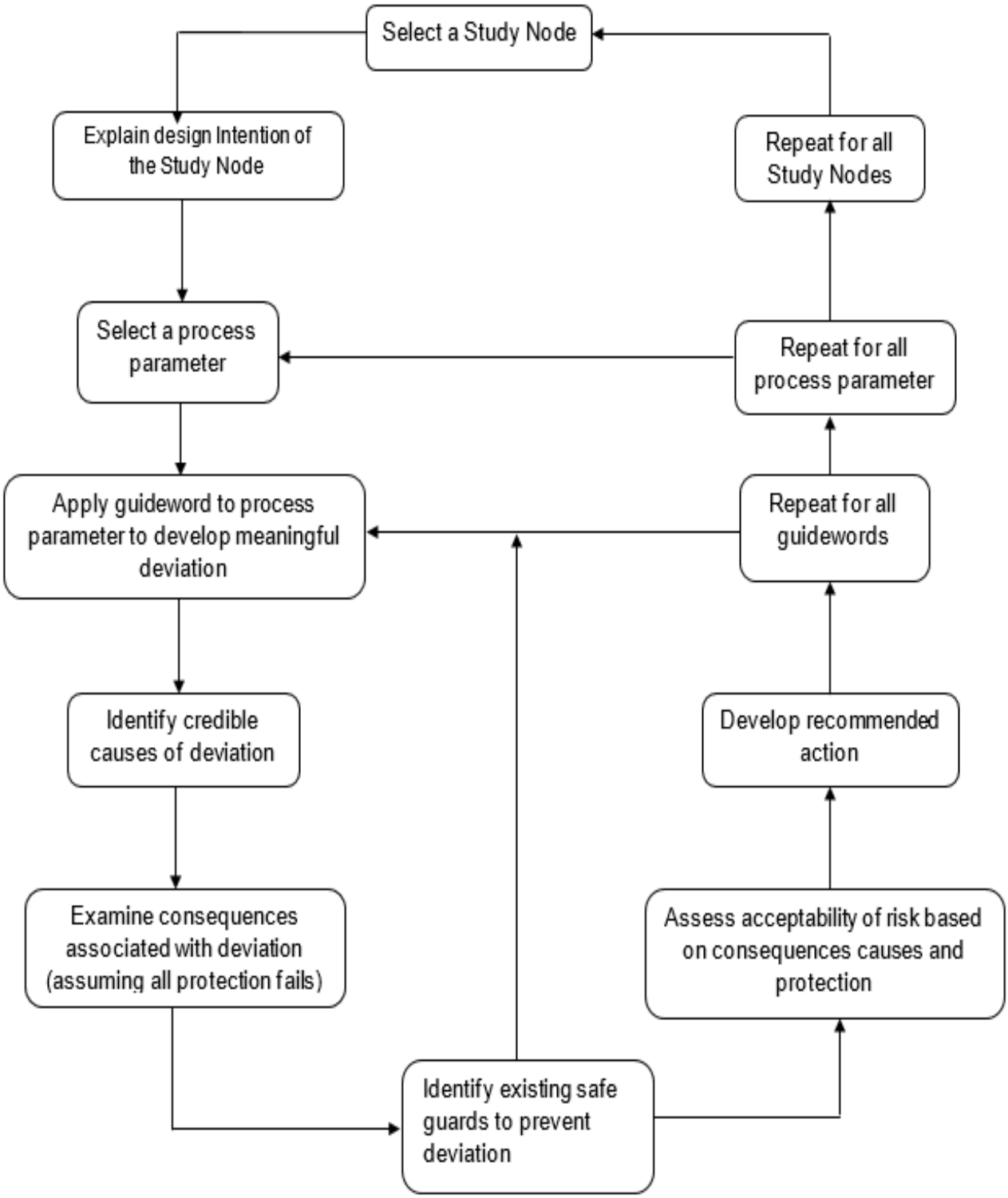
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum | vent \ process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage | Environmental damage | Business interruption | other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID, SOP, MSDS	Provided at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs, and enter the necessary data (as much as possible) in the HAZOP work sheet
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.
- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.

- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer/ Risk Analyst

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP
- Incorporate comments and issue the Final Report, within ten (10) working days of the completion of the plant HAZOP.
- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S. G. Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. S. G. Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Chetan Panchal – Electrical Mr. Smit Desai - Process Safety Mr. Kalpesh Patel- Production Mr. Smit Parikh- Process Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that

specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved operability and maintainability” categories. There were no previously unidentified

potential hazardous events with significant off-site impact determined. Please refer the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for M/s Aether Industries Ltd., Surat. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with M/s Aether Industries Ltd., Surat.

APPENDIX-1: HAZOP MINUTES

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		Title : 2CE							Plant Name: Plant-1			
Node 1		Node Description : EO INT TANK(013TK-127A/B)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
Stream-1		EO transferring in EO day tank (013TK-127A/B) from EO storage tank										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (receiving line on Day tank valve not opened).	Line may pressurize	1.Trained manpower is deputed. 2. Flow meter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	3	6				
			Low pressure in N2 line	No HSE hazard/Process Delay	1.PT is available in N2 buffer tank with low and low low alarms.	2	2	4				
			Line leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. EO sensor is provided in near by day tank. 8.Interlock is provided to closed EO transferring line ROV at high	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high value of EO sensor of EO day tank. 9.Flash alarm is provided at HH value of EO detector sensor.							
			No level in tank	No HSE hazard/Process Delay	1.LI is provided on tank to monitor the level of tank with low low alarm. 2.Flow meter is available in transferring line. 3.Interlock is provided to close the transferring line ROV at LL value of LI of storage tank.	2	1	2				
			Flowmeter malfunctioning	No HSE hazard/Process Delay	1.PM of flow meter is performed before startup. 2.LI is also available on tank to monitor the level of the tank.	2	1	2				
		High/More	Human error (Wrong input in totaliser)	Day tank may overflow	1.Trained manpower is deputed for DCS operation. 2.Day tank vent is given in dumped tank. 3.Loadcell is available on day tank with high and high high alarm. 4.LSH is available on day tank. 5.Upper limit is freezed in the totaliser to prevent more transfering of EO. 6.Interlock is provided to close ROV at given set value achieve in totaliser. 7.Interlock is provided to closed EO transferring line ROV at HH value of load cell of EO day tank. 8.Flash alarm is provided on HH value of loadcell of EO day tank. 9.interlock is provided to closed	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					transferring line ROV at LSH activation. 10.Flash alarm is provided on LSH activation.							
		Reverse		NA								
		Mis-directed flow	Human error(Wrong line up)	Line may pressurize	1. Double manual valve is available at EO header. 2.Trained manpower is deputed for operation. 3.Identification mark is provided on transferring line at main header of EO. 4.ROV is provided in separate EO line (T2E & MEP) at plant header. 5. interlock is provided to open only one ROV out of all ROV at EO header.	3	4	12				
2	Pressure	Low	No probable cause									
		High	N2 line manual valve passed/left open	Day tank may pressurise	1.Double manual valve is provided in N2 line. 2.Tank design pressure is upto 6 bar. 3.PRV is available in main nitrogen line. 4.Pressure transmitter is available with high and high high alarm. 5.PSV is available on day tank. 6.Flash alarm is provided on high high pressure of the day tank. 7.Interlock is provided to closed the transferring line ROV at HH pressure of the day tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 1		**Node Description : EO INT TANK(013TK-127A/B)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No probable cause	No HSE hazard								
		High	Chilling circulation failure due to chilling plant issue	Tank may pressurise due to temperature rise in day tank	1.TI is available on day tank with high and high alarm. 2.TI is available in chilling water return line with high high alarm. 3.Chilling plant pump trip/stop indication is available on DCS with alarm. 4.Flash alarm is provided on high high temperature of the day tank. 5.Interlock is provided to closed the transferring line ROV at HH temperature of the day tank.	3	4	12				
4	Level	Low	Loadcell malfunction	No HSE hazard/Process Delay	PM of loadcell is performed before startup.	2	3	6				
			Bottom valve leakage/passed	Health hazard & fire hazard due to spillage	SS compatible valve and metallic gasket is used. 2.Double manual valve is provided on bottom of the tank.	2	3	6				
			Line/Flange leakage		Line pressure test is performed before start up.	2	3	6				
			Tank body leakage		1.Tank MOC is compatible with material.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank and earthing continuity is checked before start-up. 2.Earthing jumper is provided in flange joint.	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 1	**Node Description : EO INT TANK(013TK-127A/B)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Instrument Air failure	Air compressor failure	Line may pressurize	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.ROV of EO transferring line air failed safe position is air failed to closed.	2	3	6				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Pure 2CE mass charging in EO + 2CE absorption reactor(013RT-038) from 2CE pure storage tank(010TK-255) &(010TK-256)**										
1	Quantity/Flow	No/Less	Human error (Bottom manual valve of 2CE storage tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Loadcell is available in tank for monitoring the level of material. 3.Flow meter is available in transferring line. 4.Line pressure test is performed before startup. 5.Compatible gasket to be used to prevent gasket leakage. 6.Over load protection is provided in material transferring pump.	3	3	9	1.Spill kit to be provided in nearby area to contain spillage. 2.Flange guard to be provided in transferring line.	2	3	6
			Human error (manual valve of 2CE storage receiving line of absorption reactor not opened).	Line may pressurise and lead to spillage /health hazard & fire hazard								
			Transferring pump trip/stops	No HSE hazard/Process delay	1.Transferring pump indication is provided on DCS. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Flange guard is provided on the flanges. 2.Line pressure test is performed before start up. 3.Compatible gasket is used to prevent gasket leakage.	3	3	9				
			Drain valve open/pass in storage tank	Health hazard& fire hazard due to spillage	1.Trained manpower is deputed for operation and ensure proper line up before startup.	3	3	9	1.Blind to be provided to all drain point open end flanges.	2	3	6

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human error (Circulation line valve open/pass) in storage tank	No HSE hazard/Process Delay	1. Manual valve available in the discharge line also. 2. Trained manpower will operate.	2	1	2				
			Low level in storage tank	No HSE hazard/Process Delay	1. Loadcell is available in the tank with low and low low alarms. 2.Flow meter is available in transferring line .	3	1	3				
			Line/Valve chocked/flow meter choked	Line may pressurise and lead to spillage /health hazard & fire hazard	Material having no choking property.	3	3	9				
		High/More	Human error (Wrong input in flow meter)/totaliser	Overflow from reactor and lead to spillage/health& fire hazard	1.Trained manpower deputed for DCS operating. 2.Reactor vent line is connected with scrubber or no open vent in reactor.so, no chances of overflow. 3.Upper limit of the totaliser is freezed as per process requirement.	3	3	9				
		Reverse	Pump trip/stop	Pump mechanical failure	NRV is provided in pump discharge line.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low pressure in storage tank(010TK-255/256)	Human error (Vent line valve of 2CE storage tank not opened) 2.vent line chocked	Storage tank may implode	1. SOP is available to open vent valve before starting transferring activity. 2. Compound type PT is available with low and low low alarms. 3.Trained manpower deputed for	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					operation. 4.Storage tank is design for full vacuum. 5.Interlock is provided to stop transferring pump at low low alarm of PT of storage tank. 6. Vent line valve is locked open condition with locked open indication tag .							
		High	Human Error (During 2CE storage charging vent line valve closed)	Reactor may pressurise	1. Compound type PT is available in the reactor with high and high high alarms. 2. Trained manpower will be deputed for this activity. 3. Practise is available to open vent line valve while charging into the reactor. 4. Reactor design pressure is 6 bar. 5. Interlock is provided to close the charging pump at HH value of PT of reactor.And same XV to be closed after 20 sec of pump stop. 6.Flash alarm is provided on HH alarm of PT of the reactor.	3	4	12				
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low flow									
		High	Refer high flow									
5	Composition	Other than	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3. N2 inertisation is performed during charging. 4.Tantalum plug is provided in reactor. 5.Rotameter is provided in nitrogen supply line to ensure nitrogen flow.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Interlock is provided that if XV closed in transferring line than same time transferring pump to be stop. 4.2CE storage charging line XV air failed safe position is air failed to closed condition.	3	3	9				
		Power Failure	GEB failure	No HSE hazard								
		DCS Failure	GEB failure	No HSE hazard								
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard								
Stream-2		**Dry HCl gas purging in EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	Low/Less	Dry HCl plant stop	No HSE hazard/Process Delay	1.Dry HCl plant all equipment indication is available on DCS.	3	2	6				
			Line/Flange leakage	Health and fire hazard may possible	1.Line pressure and leakage test is performed before start-up. 2. Compatible gasket is used.	3	3	9				
			Flow meter malfunctioning	No HSE hazard/Process Delay	1.Flow meter PM is performed as per predefine schedule.							
			Human error(manual valve of dry HCl gas receiving line is closed on absorption reactor)	Line may pressurise and lead to spillage /health hazard	1.Line pressure testing is performed before start up. 2.Compatible gasket is used .							
		High/More	Human error (Wrong set point is given in flowmeter with totaliser)	Temperature and pressure rise may possible in the absorption reactor	1.Trained manpower is deputed for DCS operation . 2.PT is provided in reactor with high and high high alarm. 3.TI is available with high and high high alarm. 4.Interlock is provided to closed the HCl purging line ROV at HH pressure and HH temperature of the absorption reactor. 5.Flash alarm is provided on HH	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					temperature and HH pressure of the absorption reactor. 6.Upper limit of the flow meter and totaliser is freez as per process requirements.							
			Flow meter malfunctioning	No HSE hazard/Process Delay	1.Flow meter PM is performed as per predefine schedule.	3	2	6				
		Mis-directed flow	Wrong line up	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure proper line up before startup. 2.ROV is available in dry HCL purging line of all absorption reactor. 3.Interlock is provided to open the only one ROV of dry HCl purging line out of all ROV of dry HCl purging line.	3	2	6				
8	Pressure	Low	Refer high Flow									
		High	Refer high flow	Reactor may pressurise and gas generation may possible								
			Reactor vent/Vapor line valve closed (Human error)		1.PT is provided in the absorption reactor with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4. Interlock is provided to closed dry HCl purging line ROV at HH pressure of the reactor. 5.Flash alarm is provided on HH pressure of the reactor.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Scrubber failure		1.scrubber circulation pump indication is available on DCS. 2. interlock is provided to closed the dry HCl gas charging line XV in case of scrubber circulation pump trip/stop.	3	4	12				
			Utiity(chilling brine) circulation failure		1.Brine circulation pump running indication is available on DCS. 2.TI is provided in utility supply and return line of the absorption reactor. 3.Interlock is provided to closed dry HCl gas purging line XV in case of brine pump circulation pump trip/stop. 4.Flash alarm is provided in case of brine plant circulation pump trip/stop.	3	4	12				
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Refer high Flow									
			TI malfunctioning	Temperature rise may possible in the reactor	PM of TI is performed as per predefine schedule.	3	4	12				
			Utility (chilling brine) circulation failure		1.Brine circulation pump running indication is available on DCS. 2.TI is provided in utility supply and return line of the absorption reactor. 3.Interlock is provided to closed dry HCl gas purging line XV incase of brine pump circulation pump trip/stop. 4.Flash alarm is provided incase of brine plant circulation all pump	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					trip/stop.							
			Parallel material charging of dry HCl and EO in place of series		1.Trained manpower is deputed for DCS operation. 1.Interlock is provided that only one ROV will open either dry HCl purging line or EO addition line at same time.	3	4	12				
10	Level	Low	Refer low flow									
			Refer high flow									
		High	Jacket puncture of the reactor	1.Material incompatibility hazard may arise 2.Overflow from reactor	1.PM of the reactor is performed as per predefine schedule. 2.Spark test is performed before start up.	3	3	9				
11	Composition	Other than	No probable cause									
12	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the reactor. 2. Earthing strip is provided on the flanges. 3.N2 blanketing to be continue while drum charging. 4.Tantalum plug is provide in the reactor.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	DG power backup is provided to the reactor.	3	1	3				
		Instrument Air Failure	Air compressor failure	Temperature rise may possible in the reactor	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of dry HCl charging line ROV is to be air failed to closed condition.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled	Exotherm may possible	1.No load tripping is provided on agitator. 2.Agitator running indication is provided on DCS. 1.Recommend to provide interlock to closed dry HCl purging line XV incase of agitator stop/trip.	3	3	9				
Stream-3		**EO addition in EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
13	Quantity/Flow	Low/Less	Human error (Bottom manual valve of EO day tank not opened).	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation and ensure that proper line up before material transferring start. 2.Flow meter is available in transferring line .	3	1	3				
			Human error (manual valve of EO receiving line on EO coupling reactor not opened).	Transferring line may pressurise	1.Line design pressure is sustain to maximum pressure.	3	3	9				
			Low pressure of N2 in EO day tank	No HSE hazard/Process Delay	1.PT is available in day tank with low and low low alarm.	3	1	3				
			Line leakage	Health hazard & fire hazard due to spillage	1.Line pressure testing is done before start-up. 2.Fire extinguisher and fire hydrant point is provided in near by area. 3. Flange guard is provided on all flanges. 4.Compatible gasket issued. 5.All electrical installation as per HAC classification.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6.EO detector is provided on absorption reactor and also indication provided on DCS with alarms and local flameproof hooter. 7. interlock is provided to closed EO addition line FCV & ROV at HH value of EO detector. 8.Flash alarm is provided on HH value of EO detector.							
			Low level in EO day tank(2KL)	No HSE hazard/Process Delay	1.Flow meter is available in addition line . 2.Loadcell is available in EO day tank with alarms.	3	1	3				
			Flow meter malfunctioning/ chocked	No HSE hazard/Process Delay	1.Flow meter PM to be performed before start the operation. 2. Choking not possible.	3	1	3				
			FCV of EO addition line stuck	No HSE hazard/Process Delay	PM of FCV is performed as per schedule.	3	1	3				
		High/More	Human error (Wrong input in Totaliser/Flow meter)	Exotherm may possible in the reactor	1. Trained manpower is deputed for operation. 3. TI is available in the reactor with high and high high alarms. 4. CHBS provision is available in jacket of the reactor to control temperature. 5.flow meter and totaliser upper limit is freez as per process requirement. 6.Interlock is provided to closed EO addition line CV & ROV at HH temperature of the absorption reactor. 3.Flash alarm is provided on HH	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					value of TI of the absorption reactor.							
			Flow meter malfunctioning		1.Flow meter PM is carried out before startup operation.	3	4	12				
			FCV of EO addition line stuck		1.PM of FCV is performed as per schedule. 2.XV is also available in EO addition line.	3	4	12				
		Mis-directed flow										
14	Pressure	Low	No probable cause									
		High	Refer high flow	Reactor may pressurise and gas generation may possible								
			Reactor vent/Vapor line valve closed (Human error)		1.PT is provided in the absorption reactor with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Interlock is provided to closed EO addition line CV & ROV at HH pressure of the reactor. 2.Flash alarm to be provide on HH pressure of the reactor.	3	4	12				
			Scrubber failure		1.scrubber circulation pump indication is available on DCS. 2.Interlock is provided to closed the EO addition CV & ROV incase of scrubber circulation pump trip/stop.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utiity(chilling brine) circulation failure		1.Brine circulation pump running indication is available on DCS. 2.TI is provided in utility supply and return line of the absorption reactor. 3.Interlock is provided to closed EO addition line CV & ROV incase of brine pump circulation pump trip/stop. 4.Flash alarm is provided incase of brine plant circulation pump trip/stop.	3	4	12				
15	Temperatur e	Low	No probable cause									
		High	Fast addition rate of EO	Exotherm and gas generation may possible	1.Flow meter, ROV and CV is available in addition line. 2.Orifice is also available in EO addition line. 3.Addition line Flow meter maximum rate is fixed at 130 kg/hr. 4.Interlock is provided to closed the addition line ROV in case of scrubber circulation pump trip/stop. 5.EO Addition line ROV is closed at HH temperature of the reactor. 6.Flash alarm is provided on HH temperature of the reactor.	3	4	12				
			More quantity of EO charged		1.Flow meter, ROV and CV is available in addition line. 2.Orifice is also available in EO addition line.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Totaliser upper limit is freezed as per process requirement. 4.Interlock is provided to closed the addition line ROV in case of scrubber circulation pump trip/stop. 5.Addition line ROV is closed at HH temperature of the reactor.							
			Parallel material charging of EO &Dry HCl inplace of series		1.Trained manpower is deputed for operation. 2.SOP is available . 3.At a time only one ROV will be open from 2CE mass , EO addition and dry HCl gas.	3	4	12				
			Brine plant pump circulation stop/Trip		1.TI is available with high and high high alarm. 2.Interlock is provided to stop the EO addition ROV when brine plant pump circulation stop. 3.Flash alarm is provided in case of brine plant circulation pump trip/stop.	3	4	12				
			TI malfunction		PM of RTD is performed as per predefine schedule.	3	4	12				
16	Level	Low	Refer low flow									
		High	Refer high flow									
			Jacket puncture of the reactor	1.Material incompatibility hazard may arise 2.Overflow from reactor	1.PM of the reactor is performed as per predefine schedule. 2.Spark test is performed before start up.	3	3	9				
17	Composition	Other than										
18	Others	Static charge	-	Fire hazard	1. Dual earthing is provided in the reactor.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 2		**Node Description : EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					2. Earthing strip is provided on the flanges. 3.N2 blanketing to be continue while drum charging. 4.Tantalum plug is provided in the reactor.							
		Power Failure	GEB power failure	No HSE hazard	DG power backup is provided to the reactor.	3	1	3				
		Instrument Air Failure	Air compressor failure	No HSE hazard	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of EO addition line ROV & CV is to be air failed to closed condition.	3	3	9				
		Agitation	Agitator decoupled	Exotherm may possible	1.No load tripping is provided on agitator. 2.Agitator running indication is provided on DCS. 3. interlock is provided to closed EO addition line ROV & CV incase of agitator stop/trip.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**2CE absorption mass transferring in storage tank from EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)**										
1	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before startup. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9	1.Flange guard to be provide on the flanges.	2	3	6
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in absorption reactor	No HSE hazard/Process Delay	No existing safeguard	2	1	2				
			Human error(manual vent line valve is closed)	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. 3.Trained manpower is deputed	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 3	**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					for operation and ensure proper line up before startup. 4.Flash alarm is provided on high high value of PT of tank. 5.Vent line valve of storage tank is locked open condition with tagging.							
		High/More	Human error(withdrawal not done regularly)	Tank may overflow	1.Trained manpower is deputed for operation. 2.Loadcell is available in tank with high and high high alarms. 3.Level switch is available in storage tank. 4.Flash alarm is provided on high high value of Loadcell of storage tank. 5.Flash alarm is provided on LSH activation.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(manual vent line valve is closed)	Tank may pressurize	1.PT is available in tank with high and high high pressure. 2.Tank is design upto 6 bar pressure. 3.Trained manpower is deputed for operation and ensure proper line up before startup. 4.Flash alarm is provided on high high value of PT of tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			N2 line PRV failure		1.Local vent is provided in the tank. 2. PT is available to monitor the pressure of tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.PM of PRV is performed as per predefine schedule. 5.N2 line maximum pressure is 1.5kg/cm2. 6.Rotameter is provided in N2 line for inertisation.	3	4	12				
3	Temperatur e	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1. PM of tank is performed before start up and as per predefine schedule. 2. Pressure test is performed before start-up. 3. Loadcell is available in tank with low and low low alarm	3	3	9				
			Bottom valve pass/leakag e		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to storage tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 3		**Node Description : 2CE absorption mass storage tank(011ST-035/011ST-036)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from 2CE absorption mass storage tank(011ST-035/036) to distillation column(011CM-018) through feeding pump (011TP-130/131)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line. 3.Pump running indication is provided on DCS. 4.Interlock is provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	3	1	3				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve in pump	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			discharge line and feeding line of column is not opened)		3. Inbuilt PSV is available in the pump.							
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area. 3.Double valve/blind is provided to prevent valve passing/leakage. 4.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctioni ng/Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms.	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provide on high high value of LI of column.							
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	2	6				
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (011CM-018)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms. 5. Interlock isprovided to stop the CV & XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the column. 8. Flash alarm is provided at HH temperature and HH pressure of the column.	3	4	12				
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2. PT is available in distillation column with high and high high	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					alarm. 3.At HH pressure of top and bottom of the column reboiler steam TCV is closed and at a same time feeding pump to be stop and bottom collection CV to be closed. 4..Flash alarm is provided on HH pressure of top and bottom of the column.							
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 3.PT is also available in cooling tower pump discharge line with low and low low alarms. 4.TI is provided in vapour line from primary to secondary condenser line. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump is stop.and also bottom collection CV is closed.	3	4	12				
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms. 5.TCV stroke testing is carried out as per define schedule. 6.Flash alarm is provided on HH temperature of top and bottom of the column. 7.Interlock is provided that at HH temperature of top & bottom of the column steam TCV is closed and same time bottom collection CV is closed.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation.	4	3	12	1.TCV bypass valve should be locked closed condition with tagging.	2	3	6
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm. 3.Interlock is provided that in case of bottom withdraw pump trip/stop than steam TCV to be closed. 4.Interlock is provided that at HH value of LI of column feeding pump to be stop.	3	1	3				
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS. 3.CV stroke testing is carried out as per defined PM schedule.	3	1	3				
			Human error (steam TCV is not open)		1.steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	4	1	4				
			High reflux		1.Flow meter is available in	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			flow rate		reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.							
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.steam TCV air fail safe position is air failed to close. 4.Distillation column top collection & bottom collection CV air fail safe position is air failed to closed condition.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-3		**Top collection in pure 2CE receiver(010TK-255) & distilled 2CE receiver(010TK-256)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	2.Double valve/blind provision to prevent valve passing/leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump is stop.and also bottom collection CV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	1.Control valve stroke testing is carried out as per PM schedule.	2	1	2				
			Vent line valve is not open of 2CE receiver	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation and ensure vent line valve is open before startup. 3.Tank design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.Steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	2	1	2				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Loadcell is available with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard. 5.LSH is also available in collection tank. 6.Flash alarm is provided on high high value of Loadcell & level switch activation of receiver. 7. interlock is provided to closed top collection line CV at HH value of loadcell & LSH activation.	3	3	9				
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					temperature of top of the column steam TCV is closed and same time feeding pump and bottom withdraw pump is stop and top & bottom collection CV is closed.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. PT is available with HH alarms. 3.Vent line valve is made available in critical locked open condition and tag to be provide on valve. 4. Flash alarm is provided at HH pressure of tank.	3	4	12				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. Load cell is available in the collection receiver with low and low low alarms. 4. Spill kit is provided in the	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					nearby area to contain spillage. 5.Equipment thickness testing is carried out as per define schedule.							
			Bottom valve pass/leakage		No existing safeguard	3	3	9	1.Double valve is available to prevent valve passing/leakage.	2	3	6
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal taken in CM-018 & 066 bottom withdrwal tank (010ST-212)**										
19	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.LI is available in sump of distillation column with high and high alarms. 3.Flash alarm is provide on HH value of LI of sump of distillation column. 2.Interlock to be provide that if bottom withdrawal pump stop/trip than at same time steam TCV, bottom collection line CV to be closed.							
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	2.Double valve provision is available to prevent valve passing/leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	3	1	3				
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay	CV stroke testing is carried out as per PM schedule.	3	3	9				
			Human error(Vent line valve is not open)	Tank may pressurize	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.Flash alarm on HH value of PT of the tank.	3	4	12				
			Flow meter malfunction	Process delay	1.Loadcell is available in bottom collection receiver to monitor the level. 2. Flow meter PM is done periodically.	3	1	3				
		High/More	Bottom collection CV passed	Overflow may possible	1.Loadcell is available in bottom collection receiver with high and high high alarm.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 4		**Node Description : 011CM-018 (Continous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bypass valve of CV passed/left open		2.Interlock is provided that at HH value of Loadcell of receiver bottom collection CV to be closed. 3.Flash alarm is provided on HH value of loadcell of the bottom collection receiver.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. Receiver design pressure is 6 bar. 3.PT is available in tank with high and high high alarm. 3.Vent line valve is made available in critical locked open condition and tag to be provide on valve. 4.Flash alarm is provided on HH value of PT of the bottom collection tank. 5.Interlock to closed bottom collection line CV at HH value of PT of the bottom collection tank.	3	4	12				
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/pas	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 4	**Node Description : 011CM-018 (Continous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			sed									
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2.Loadcell is available in the tank with low and low low alarms. 3. Spill kit is provided in the nearby area to contain spillage. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Bottom collection line CV air failed safe position is to be air failed to closed condition.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 4	**Node Description : 011CM-018 (Continous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Continuous feeding from 2CE absorption mass storage tank(011ST-035/036) to distillation column(021CM-066) through feeding pump (011TP-130/131)**										
1	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Mass flow meter is provided in feeding line with alarm. 2.PG is available in pump discharge line. 3.Pump running indication is provided on DCS. 4.Interlock is provided that if feeding pump to be stop than top collection & bottom withdraw CV to be closed.	4	1	4				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve in pump discharge line and feeding line of column is	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3. Inbuilt PSV is available in the pump.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			not opened)									
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Fire hydrant points& fire extinguisher are available in near by area. 2.All electrical equipment are flameproof in near by area. 3. double valve/blind provision is prevent valve passing/leakage. 2.Spill kit is provided to contain spillage.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay								
			Flow meter malfunctionin g/Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow meter to be performed before startup.	2	3	6				
		High/More	Human error (Feeding pump run with full capacity)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit to is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on	3	2	6				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					high high value of LI of column.							
			Human error (Wrong set point of feed flow is given in feeding line mass flow meter)	Flooding may possible in column/Process Delay	1.Mass flow meter with totaliser is available inn feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	2	6				
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	Human error(Feeding pump circulation line valve left open)	No HSE hazard/Process Delay								
2	Pressure	Low	No probable cause									
		High	No probable cause									
3	Temperatur e	Low	No probable cause									
		High	No probable cause									
4	Level	Low	Refer low Flow									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Refer high Flow									
5	Compositio n	Other than	No probable cause									
6	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard								
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-2		**Continuous distillation in distillation column (021CM-066)**										
7	Quantity/Fl ow	No/Less	Refer low flow of stream 1									
		High/More	Refer high flow of stream 1									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
8	Pressure	Low	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the column & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the CV & XV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the column. 8. Flash alarm is provided at HH temperature and HH pressure of the column.	3	4	12				
		High	Human error(Vent line manual valve is closed)	Distillation column may pressurize	1.Trained manpower will operate the operation and ensure vent valve is open before startup. 2. PT is available in distillation column with high and high high alarm. 3.At HH pressure of top and bottom of the column reboiler steam TCV is closed and at a same time feeding pump is stop and bottom collection CV to be closed.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4..Flash alarm is provided on HH pressure of top and bottom of the column.							
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 3.PT is also available in cooling tower pump discharge line with low and low low alarms. 4.TI is provided in vapour line from primary to secondary condenser line. 5.TI is provided in final vent line. 6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump to be stop.and also bottom collection CV to be closed.	3	4	12				
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure and bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.3 no of TI is provided in column with high and high high alarms. 5.Flash alarm is provided on HH temperature of top and bottom of the column.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6.Interlock is provided that at HH temperature of top & bottom of the column steam TCV is closed and same time bottom collection CV is closed.							
			Human error(TCV bypass line passed/open)		1.Trained manpower will perform the operation. 22.TCV bypass valve is locked closed condition with tagging.	3	3	9				
			TI malfunctioning of column		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per Pre-defined schedule. 3.TI is also available in top,middle and bottom section of the column. 4.3 no of PT is provided in distillation column.	2	3	6				
10	Level	Low	Column leakage	Fire hazard and chemical exposure	1.Pressure testing to be carried out before startup. 2.Fire hydrant points& fire extinguisher are available in near by area. 3..All electrical equipment are flameproof in near by area.	2	3	6				
		High	Reboiler circulation/bottom withdraw pump trip/stop	No HSE hazard/Process Delay	1.Bottom withdraw pump running indication is available on DCS. 2.LI is available in sump of the column with high and high high alarm. 3.Interlock is provided that in case of bottom withdraw pump	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					trip/stop than steam TCV to be closed. 4.Interlock is provided that at HH value of LI of column feeding pump to be stop.							
			Bottom withdraw CV stuck		1.Bottom withdraw CV indication is available in DCS. 2.Flow meter is available in bottom withdrawal line with indication in DCS. 3.CV stroke testing is carried out as per defined PM schedule.	3	1	3				
			Human error (steam TCV is not open)		1.steam TCV opening indication is available in DCS. 2.Trained manpower is deputed for operation. 3..LI is available in sump of the column with high and high high alarm.	3	1	4				
			High reflux flow rate		1.Flow meter is available in reflux line with high and high high alarms. 2..LI is available in sump of the column with high and high high alarm.	3	1	3				
			Tube leakage in condenser	Column may overflow and overload/ Material incompatible hazard	1.Pressure test is performed before start-up. 2.LI is available in sump of the column at HI and HH alarm. 3.Compatible utility is used in condenser .so,no chances of incompatible hazard.	3	3	6				
11	Composition	Other than	No probable cause									
12	Others	Static	-	Fire hazard	1. Double earthing is provided to	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Electricity			reactor. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.							
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.steam TCV air fail safe position is air failed to close. 4.Distillation column top collection & bottom collection CV air fail safe position is air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-3		**Top collection in collection receiver(013TK-340)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	4	1	4				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Double valve/blind provision is available to prevent valve passing/leakage.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low low alarm.	2	1	2				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water and chilling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in final vent line.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					6.At HH temperature of final vent line steam TCV is closed and at a same time feeding pump is stop.and also bottom collection CV to be closed.							
			Top collection line CV stuck	No HSE hazard	1.Control valve stroke testing is carried out as per PM schedule.	2	1	2				
			Vacuum balancing line valve is not open	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation and ensure vent line valve is open before startup. 3.Tank design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.Steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	2	1	2				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.LI is available in collection receiver with high and high high alarms. 3.Flow meter is available in reflux line and collection line with high and high high alarms. 4.Compatible utility is used in condenser .so,there are no chances of incompatibility	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					hazard. 5.Flash alarm is provided on high high value of LI of collection receiver. 6.Interlock is provided to closed top collection line CV at HH value of LI of receiver.							
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV is closed and same time feeding pump and bottom withdraw pump is stop and top & bottom collection CV is closed.	3	4	12				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not open	Tank may pressurize	1.PT is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation and ensure vent line valve is open before startup. 3.Tank design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
15	Temperature	Low	No probable cause		TI is available in collection receiver							
		High	No probable cause		TI is available in collection receiver							
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3.LI is available in the collection receiver with low and low low alarms. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay								
		Power Failure	GEB power failure	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-4		**Bottom withdrawal taken in CM-018 & 066 bottom withdrwal tank (010ST-212)**										
19	Quantity/Flow	No/Less	Bottom withdrawal pump stop/trip	Flooding may possible in column/Process Delay	1.Bottom withdrawal pump running indication is available on DCS. 2.PG is available in pump discharge line. 3.LI is available in sump of distillation column with high and high alarms. 4.Flash alarm is provided on HH value of LI of sump of distillation column. 5.Interlock is provided that if bottom withdrawal pump stop/trip than at same time steam TCV, bottom collection line CV is closed.	3	3	9				
			Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7.Line is design to resist maximum discharge pressure of	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pump. 8. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of bottom withdraw collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Sample point/Drain point manual valve pass	Fire hazard and chemical exposure	1.Double valve is provided to prevent valve passing/leakage.	3	3	9				
			No/low level in distillation column	No HSE hazard/Process Delay	LI is available in sump of the distillation column with low and low alarm.	3	1	3				
			Bottom withdrawal CV stuck	No HSE hazard/Process Delay	CV stroke testing is carried out as per PM schedule.	3	3	9				
			Human error(Vent line valve is not open)	Tank may pressurize	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.PT is available in tank with high and high high alarm. 3.Tank design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the tank.	3	4	12				
			Flow meter malfunction	Process delay	1.Loadcell is available in bottom collection receiver to monitor the level. 2.Flow meter PM is done	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					periodically.							
		High/More	Bottom collection CV passed Bypass valve of CV passed/left open	Overflow may possible	1.Loadcell is available in bottom collection receiver with high and high high alarm. 2.Interlock is provided that at HH value of Loadcell of receiver bottom collection CV is closed. 2.Flash alarm is provided on HH value of loadcell of the bottom collection receiver.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower will deputed for operation and verified valve position before startup. 2. Receiver design pressure is 6 bar. 3.PT is available in tank with high and high high alarm. 4.Flash alarm is provided on HH value of PT of the bottom collection tank. 5.Interlock is provided to closed bottom collection line CV at HH value of PT of the bottom collection tank.	3	4	12	1.Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	2	4	8
21	Temperature	Low	No probable cause									
		High	Oil TCV opened/passed	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
22	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Pressure test is performed before start-up. 2.Loadcell is available in the tank with low and low low alarms. 3. Spill kit is provided in the nearby area to contain spillage. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Compositio n	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to the tank. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Bottom collection line CV air failed safe position is to be air failed to closed condition.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									
Stream-5	**Top collection receiver (013TK-340) unloading in pure 2CE receiver(020ST-210) & Distilled 2CE receiver(020ST-211)**											
25	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Interlock is provided that at HH pressure of the tank transferring line ROV is closed. 4.Flash alarm is provided at HH value of PT of the storage tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5		**Node Description : 021CM-066 (Continuous Distillation Column)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Loadcell malfunctioning in both collection tank	Tank may overflow	1.PM of Loadcell is performed as per predefine schedule. 2.LSH is available in tank with high and high high alarm. 3.Interlock is provided that transferring line ROV is closed incase of LSH activation. 4.Flash alarm is provided incase of LSH activation.	3	3	9				
			LSH malfunctioning in both collection tank		1.PM of LSH is performed as per predefine schedule. 2.Loadcell is available in tank with high and high high alarm. 3.Interlock is provided that transferring line ROV is closed incase of HH value of loadcell of the tank. 4.Flash alarm is provided incase of HH value of Loadcell of the tank.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
26	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Interlock is provided that at HH pressure of the tank transferring line ROV is closed. 4.Flash alarm is provided at HH	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					value of PT of the storage tank.							
27	Temperature	Low	No probable cause									
		High	No probable cause									
28	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage. 2.ROV is also available in line.	3	3	9				
		High	Refer high Flow									
29	Composition	Other than	No probable cause									
30	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4. Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.2CE mass transferring line ROV air failed safe position is to	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 5	**Node Description : 021CM-066 (Continuous Distillation Column)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					be air failed to closed condition.							
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CM-018 & 066 bottom withdrawal transfer to CEE pure distillation reactor(011RT-042)**										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 4.Flange guard is provided on the flanges. 5.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				
			Storage tank vent valve is closed(CM-018 &066 bottom withdrawal tank)	Tank may implode	1.PT available in the tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					after 10 seconds of pump stopped at LL value of PT of the storage tank. 5.Flash alarm is provided to LL value of PT of the storage tank. 6.Vent line valve is locked open condition with tagging.							
			Low level in storage tank	No HSE hazard/Process Delay	1.Loadcell is available in tank to monitor the level of tank.	3	1	3				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup.	3	3	9				
		High/More	No credible cause									
		Reverse	Pump trip/stops	Pump mechanical damage	NRV to be provide in the pump discharge line to prevent reverse flow.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent line valve is closed)	Reactor may pressurise	1.PT is available in tank with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation. 4..Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at HH value of PT of CEE pure distillation reactor. 5.Flash alarm is provided on HH value of PT of CEE pure	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6	**Node Description : CEE pure distillation reactor(011RT-042)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					distillation reactor.							
3	Temperature	Low	No credible cause		TI is available in reactor.							
		High	No credible cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is air failed to close condition. 4.Interlock is provided to stop the transferring pump when transferring line XV is closed.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Agitator decoupled due to mechanical failure	No HSE hazard/Process Delay								
Stream-2		**Pure CEE distillation in CEE pure distillation reactor(011RT-042)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					8. Flash alarm is provided at HH temperature and HH pressure of the reactor.							
		High Vacuum	No probable cause	No HSE hazard								
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the XV of vacuum line in case of vacuum drop & vacuum trip/stops. 6. Interlock is provided to stop steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature of the reactor. 8. Flash alarm is provided at HH temperature of the reactor.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					5.PM of TCV is performed before start operation.							
			Human error(TCV bypass line passed/open)		No existing safeguard	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provide to prevent valve passing. 5.Spill kit is provided in the nearby area to contain spillage.	3	3	9				
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					position is air fail to close. 5.ROV of vacuum line air fail safe position is air fail to open.							
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping is provided. 2.steam TCV is closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Collection of pure/mix CEE in receiver(012TK-086 & 012TK-087)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			on receiver is not open)									
			No/low level in distillation column	No HSE hazard/Process Delay	1.Batch wise fixed quantity material is charged into reactor before start distillation.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.At HH temperature of final vent line steam TCV is closed. 8.Interlock is provided that if all circulation pump of cooling water and chilling water is stop than steam TCV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	CV stroke treating is carried out as per predefine schedule.	3	1	3				
			Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.steam TCV indication is available on DCS.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	3	1	3				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Flow meter is available in reflux line and collection line with high and high high alarms. 3.Compatible utility is used in condenser .so ,there are no chances of incompatibility hazard.	3	3	9				
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure.	3	3	9				
15	Temperatur e	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6	**Node Description : CEE pure distillation reactor(011RT-042)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver with low and low low alarms. 4. Spill kit is provided in the nearby area to contain spillage. 5.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Top collection receiver (012TK-086) unloading in pure 2CE receiver(010TK-255) & Distilled 2CE receiver(010TK-256)**										
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					pressure. 4.Flash alarm is provided at HH value of PT of the storage tank.							
		High/More	Loadcell malfunctioning in both collection tank	Tank may overflow	1.PM of Loadcell is performed as per predefine schedule. 2.LSH is available in tank with high and high high alarm. 3.Flash alarm is provided incase of LSH activation.	3	3	9				
			LSH malfunctioning in both collection tank		1.PM of LSH is performed as per predefine schedule. 2.Loadcell is available in tank with high and high high alarm. 3.Flash alarm is provided in case of HH value of Loadcell of the tank.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank.	3	4	12				
21	Temperature	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6		**Node Description : CEE pure distillation reactor(011RT-042)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause									
22	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Compositio n	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 6	**Node Description : CEE pure distillation reactor(011RT-042)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CM-018 & 066 bottom withdrawal transfer to 2CE distillation reactor(011RT-158)**										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 4.Flange guard is provided on the flanges. 5.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				
			Storage tank vent valve is closed(CM-018 &066 bottom withdrwal tank)	Tank may implode	1.PT available in the tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at LL value of PT of the	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					storage tank. 5.Flash alarm is provided to LL value of PT of the storage tank. 6.Vent line valve is locked open condition with tagging.							
			Low level in storage tank	No HSE hazard/Process Delay	1.Loadcell is available in tank to monitor the level of tank.	3	1	3				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup.	3	3	9				
		High/More	No credible cause									
		Reverse	Pump trip/stops	Pump mechanical damage	NRV to be provide in the pump discharge line to prevent reverse flow.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent line valve is closed)	Reactor may pressurise	1.PT is available in tank with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at HH value of PT of CEE pure distillation reactor. 5.Flash alarm is provided on HH value of PT of CEE pure distillation reactor.	3	4	12				
3	Temperatur	Low	No credible		TI is available in reactor.							

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	e		cause									
		High	No credible cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is air failed to close condition. 4.Interlock is provided to stop the transferring pump when transferring line XV is closed.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to mechanical	No HSE hazard/Process Delay								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			failure									
Stream-2		**Distillation in 2CE distillation reactor(011RT-158)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.	3	4	12				
		High Vacuum	No probable	No HSE hazard								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 7. Flash alarm is provided at HH temperature and HH pressure of the reactor.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed before start operation.	3	4	12				
			Human error(TCV bypass line		1.TCV bypass valve should be locked closed condition with tagging.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			passed/open)									
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 2.Spill kit to be provided in the nearby area to contain spillage.	3	3	9				
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe position is air fail to close. 5.ROV of vacuum line air fail	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					safe position is air fail to open.							
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.steam TCV to be closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Collection of pure/mix cut 2CE in receiver(013TK-344 & 013TK-345)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area.	3	3	9				
			Human Error (Manual valve of material collection line on receiver is not open)	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			No/low level in distillation column	No HSE hazard/Process Delay	1.Batch wise fixed quantity material is charged into reactor before start distillation.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.At HH temperature of final vent line steam TCV is closed. 8. Interlock is provided that if all circulation pump of cooling water and chilling water is stop than steam TCV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	CV stroke teating is carried out as per predefine schedule.	3	1	3				
			Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure.	3	3	9				
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Flow meter is available in reflux line and collection line with high and high high alarms. 3.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard. 4.LI is available in collection receiver with high and high high alarm. 5.Flash alarm is provided on HH value of LI of the receiver. 6.Interlock is provided to closed top collection line CV at HH value of LI of top collection receiver.	3	3	9				
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provided on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure. 4.PT is available in collection receiver with high and high high alarm. 5.Flash alarm is provided on HH value of PT of the receiver. 6.Interlock is provided to closed top collection line CV at HH value of PT of top collection receiver.	3	3	9				
15	Temperatur e	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3. LI is available in the collection receiver with low and low low alarms. 4. Spill kit is provided in the nearby area to contain spillage. 5.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Top collection receiver (013TK-344) unloading in CM-018 & 066 bottom withdrwal tank(010ST-212)**										
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5.Interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				
		High/More	Human error(withdrwal not done at regularly)	Tank may overflow	1.Loadcell is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation. 3.Flash alarm is provided at HH value of loadcell of storage tank. 4. interlock is provided to closed transferring line XV at HH value	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					of loadcell of storage tank.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provideded at HH value of PT of the storage tank. 5. interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				
21	Temperature	Low	No probable cause		TI is available in tank.							
		High	No probable cause		TI is available in tank with high and high high alarm.							
22	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 7		**Node Description : 2CE distillation reactor(011RT-158)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of 2CE transferring line XV is air failed to closed condition with tagging.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-5		**Top collection receiver (013TK-345) unloading in CEE pure storage reactor(011RT-159)**										
25	Quantity/Flo	No/Less	Line/Flange	Fire hazard and	1.Compatible gasket is used to	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7	**Node Description : 2CE distillation reactor(011RT-158)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	w		leakage	chemical exposure	prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.							
			Human Error (Manual valve of material collection line on reactor is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve of reactor is not opened)	Reactor may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Reactor is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage reactor. 5.interlock is provided to closed transferring line ROV at HH value of PT of storage reactor.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 7	**Node Description : 2CE distillation reactor(011RT-158)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (withdrawal not done at regularly)	Reactor may overflow	1.LI is available in reactor with high and high high alarm. 2.Trained manpower is deputed for operation. 3.LSH is also provided in storage reactor. 4.Flash alarm is provided at HH value of LI & LSH activation of storage reactor. 5.Interlock is provided to closed transferring line XV at HH value of LI &LSH activation of storage reactor.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
26	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve of reactor is not opened)	Reactor may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Reactor is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage reactor. 5.Interlock is provided to closed transferring line ROV at HH value of PT of storage reactor.	3	4	12				
27	Temperature	Low	No probable cause		TI is available in tank.							

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 7	**Node Description : 2CE distillation reactor(011RT-158)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	No probable cause		TI is available in tank with high and high high alarm.							
28	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.LI is available to monitor the level of the storage reactor.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
29	Composition	Other than	No probable cause									
30	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of 2CE transferring line XV is air failed to closed condition with tagging.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 7	**Node Description : 2CE distillation reactor(011RT-158)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CM-018 & 066 bottom withdrwal transfer to 2CE distillation reactor(021RT-155)**										
1	Quantity/Flow	No/Less	Centrifugal pump trip/stops	No HSE hazard	Pump running indication is available on DCS.	3	1	3				
			Line/Flange leakage	Spillage may lead to health hazard &fire hazard	1.Line pressure test is performed before start-up. 2.Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Solvent resistant). 3.Compatible gasket is used to prevent gasket leakage. 4.Flange guard is provided on the flanges. 5.Spill kit is provided to contain spillage.	3	3	9				
			Human Error (Discharge Valve not opened)	No HSE hazard/Process Delay	Trained manpower will perform transferring activity.	3	2	6				
			Drain valve pass/opened	Spillage may lead to health hazard & chemical exposure.	Double manual valve provided at drain point.	2	3	6				
			Storage tank vent valve is closed(CM-018 &066 bottom withdrwal tank)	Tank may implode	1.PT available in the tank with low and low low alarm. 2.Tank is design for full vacuum. 3.Trained manpower is deputed for operation and ensure proper line up. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					stopped at LL value of PT of the storage tank. 5.Flash alarm is provided to LL value of PT of the storage tank. 6.Vent line valve is locked open condition with tagging.							
			Low level in storage tank	No HSE hazard/Process Delay	1.Loadcell is available in tank to monitor the level of tank.	3	1	3				
			Line chocked	Line may pressurise	Line pressure testing is performed before startup.	3	3	9				
		High/More	No credible cause									
		Reverse	Pump trip/stops	Pump mechanical damage	NRV to be provide in the pump discharge line to prevent reverse flow.	3	2	6				
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause									
		High	Human error(vent line valve is closed)	Reactor may pressurise	1.PT is available in tank with high and high high alarm. 2.Reactor design pressure is upto 6 bar. 3.Trained manpower is deputed for operation. 4.Interlock is provided to stop the tank unloading pump & closed transferring line ROV after 10 seconds of pump stopped at HH value of PT of CEE pure distillation reactor. 5.Flash alarm is provided on HH value of PT of CEE pure distillation reactor.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
3	Temperature	Low	No credible cause		TI is available in reactor.							
		High	No credible cause		TI is available in reactor with high and high high alarm.							
4	Level	Low	Refer low Flow									
		High	Refer high Flow									
5	Composition	Other than	No probable cause									
6	Others	Static charge	-	Fire hazard	1. Earthing jumpers are provided in the transferring line. 2. Double earthing is provided in the reactor. 3. Before start-up earthing testing is performed.	3	3	9				
		Instrument Air failure	Air compressor failure	Line may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is air failed to close condition. 4. interlock is provided to stop the transferring pump when transferring line XV is closed.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Agitator decoupled due to	No HSE hazard/Process Delay								

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			mechanical failure									
Stream-2		**Distillation in 2CE distillation reactor(021RT-155)**										
7	Quantity/Flow	No/Less	No probable cause									
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low /No Vacuum	1. Line leakage 2. Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor with high and high high alarms. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High Vacuum	No probable cause	No HSE hazard								
9	Temperature	Low	No probable cause	No HSE hazard								
		High	Vacuum pump trip/stops	Temperature rise may possible in the reactor	1. CV is available on the vacuum pot. 2. Leakage test is performed before start-up. 3. Compound PT is available on the reactor. 4. TI is available in the reactor & condenser vent line with high and high high alarms. 5.Interlock is provided to stop the XV & CV of vacuum line in case of vacuum drop & vacuum pump trip/stops. 6. Interlock is provided to close steam TCV at vacuum drop & vacuum pump trip/stops. 7. Interlock is provided to stop steam line TCV at HH temperature and HH pressure of the reactor. 8. Flash alarm is provided at HH temperature and HH pressure of the reactor.	3	4	12				
			TCV failure/stuck open		1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 5.PM of TCV is performed	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					before start operation.							
			Human error(TCV bypass line passed/open)		1.TCV bypass valve should be locked closed condition with tagging.	3	4	12				
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule.	2	4	8				
10	Level	Low	Reactor leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage 2.Fire hazard due to spillage	1. Reactor design pressure is 6 bar. 2. Pressure test & PM is performed before start-up. 3.All electrical installation are flameproof as per HAC classification. 4. Double manual valve is provided to prevent valve passing. 5.Spill kit is provided in the nearby area to contain spillage.	3	3	9				
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position is air fail to close. 4.PCV of vacuum pot air fail safe	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					position is air fail to close. 5.ROV of vacuum line air fail safe position is air fail to open.							
		Power Failure	GEB power failure		Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure		Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.Agitator no load tripping to be provided. 2.steam TCV to be closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Collection of pure/mix cut 2CE in receiver(013TK-341 & 013TK-342)**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material	No HSE hazard/Process Delay	Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			collection line on receiver is not open)									
			No/low level in distillation column	No HSE hazard/Process Delay	1.Batch wise fixed quantity material is charged into reactor before start distillation.	3	1	3				
			Utility failure in condenser	Fire hazard and chemical exposure	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary condenser line. 6.TI is provided in final vent line. 7.At HH temperature of final vent line steam TCV is closed. 8.Interlock is provided that if all circulation pump of cooling water and chilling water is stop than steam TCV to be closed.	3	3	9				
			Top collection line CV stuck	No HSE hazard	CV stroke teating is carried out as per predefine schedule.	3	1	3				
			Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Heating stopped	No HSE hazard/Process Delay	1.Trained manpower is deputed for operation. 2.steam TCV indication is available on DCS.	3	1	3				
			Flow meter malfunction	No HSE hazard/Process Delay	Flow meter PM is performed as per predefine schedule.	3	1	3				
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Receiver may overflow	1.Pressure test is performed before start-up. 2.Flow meter is available in reflux line and collection line with high and high high alarms. 3.Compatible utility is used in condenser .so,there are no chances of incompatibility hazard. 4.LSH is available in collection receiver. 5.Interlock is provided to provide flash alarm on LSH activation of the receiver. 6.Interlock is provided to closed top collection line CV at LSH activation of the receiver.	3	3	9				
			Human error(steam TCV more percentage open)	Pressure rise may possible in column	1.Trained manpower is deputed for operation. 2.3 no of TI is available in distillation column with alarms. 3.Flash alarm is provide on HH temperature of top of the column. 4.Interlock is provided that at HH temperature of top of the column steam TCV to be closed.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 8	**Node Description : 2CE distillation reactor(021RT-155)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Vacuum balancing line valve is not open	Receiver may pressurise	1.Trained manpower is deputed for operation. 2.PG is available on receiver. 3.Receiver design for upto 6 bar pressure. 4.PT is available in collection receiver with high and high high alarm. 5.Flash alarm is provided on HH value of PT of the receiver. 6. interlock is provided to closed top collection line CV at HH value of PT of top collection receiver.	3	3	9				
15	Temperature	Low	No probable cause									
		High	No probable cause									
16	Level	Low	Receiver leakage	Fire hazard and chemical Exposure	1. Collection receiver design pressure is 10 bar & design temperature is 200 deg C. 2. Pressure test is performed before start-up. 3.Spill kit is provided in the nearby area to contain spillage. 4.Equipment thickness testing is carried out as per define schedule.	3	3	9				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Bottom valve pass/leakage		Double valve is available to prevent valve passing/leakage.	3	2	6				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in near by area. 4.All electrical equipment are flameproof in near by area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-4		**Top collection receiver (013TK-341) unloading in pure 2CE receiver(020ST-210) & Distilled 2CE receiver(020ST-211)**										

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
19	Quantity/Flow	No/Less	Line/Flange leakage	Fire hazard and chemical exposure	1.Compatible gasket is used to prevent gasket leakage. 2.Flange guard is provided on the flanges. 3.Line pressure test is performed before start up. 4.150 class flange is used. 5.Fire hydrant points& fire extinguisher are available in near by area. 6.All electrical equipment are flameproof in near by area. 7. Spill kit is provided in the nearby area to contain spillage.	3	3	9				
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will deputed for operation and verified valve position before startup.	3	1	3				
			Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5.Interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1		**Title : 2CE**							**Plant Name: Plant-1**			
Node 8		**Node Description : 2CE distillation reactor(021RT-155)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error(withdrwal not done at regularly)	Tank may overflow	1.Loadcell is available in tank with high and high high alarm. 2.Trained manpower is deputed for operation. 3.LSH is also available in storage tank. 4.Flash alarm is provided at HH value of loadcell of storage tank. 5.Interlock is provided to closed transferring line XV at HH value of loadcell of storage tank. 6.Interlock is provided to closed transferring line ROV at LSH activation of storage tank. 7.Flash alarm is provided on LSH activation of storage tank.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
20	Pressure	Low	No probable cause									
		High	Human error(Manual vent valve is not opened)	Tank may pressurize	1.Trained manpower is deputed for operation. 2.PT is available on tank with high and high high alarm. 3.Tank is design for upto 6 bar pressure. 4.Flash alarm is provided at HH value of PT of the storage tank. 5.Interlock is provided to closed transferring line ROV at HH value of PT of tank.	3	4	12				
21	Temperatur	Low	No probable		TI is available in tank.							

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8	**Node Description : 2CE distillation reactor(021RT-155)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
	e		cause									
		High	No probable cause		TI is available in tank with high and high high alarm.							
22	Level	Low	Tank body leakage	Fire hazard and chemical Exposure	1.Tank thickness testing is performed as per PM schedule. 2. Spill kit is provided in the nearby area to contain spillage. 3.Equipment thickness testing is carried out before startup. 4.Loadcell is available to monitor the level of the tank.	3	3	9				
			Bottom valve pass/leakage		1.Triple manual valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
23	Composition	Other than	No probable cause									
24	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to receiver. 2.Fire hydrant points& fire extinguisher are available in near by area. 3.All electrical equipment are flameproof in near by area. 4.Earthing continuity is verified before start-up.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of 2CE transferring line XV is air failed to closed condition with tagging.	3	1	3				

HAZOP study of 2CE												
P &ID number : AIL-PID-2CE-SHEET-1			**Title : 2CE**						**Plant Name: Plant-1**			
Node 8	**Node Description : 2CE distillation reactor(021RT-155)**											
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

---- END OF THE REPORT -----

HAZOP -2CE						
Sr No	Node	Stream	Recommendations	Department	Status	PAGE NO
1	EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-	Pure 2CE mass charging in EO + 2CE absorption reactor(013RT-038) from 2CE pure storage tank(010TK-255) &(010TK-256)	Flange guard to be provided in transferring line.	Mechanical	COMPLETED	1
2			Blind to be provided to all drain point open end flanges.	Mechanical	COMPLETED	2
3	2CE absorption mass storage tank(011ST-035/011ST-036)	2CE absorption mass transferring in storage tank from EO +2CE Absorption reactor(013RT-038/013RT-039/012RT-156/012RT-116/012RT-117/012RT-118/012RT-157)	Flange guard to be provide on the flanges.	Mechanical	COMPLETED	3
4	011CM-018 (Continous Distillation Column)	Continuous distillation in distillation column (011CM-018)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	COMPLETED	4
5	021CM-066 (Continous Distillation Column)	Bottom withdrawal taken in CM-018 & 066 bottom withdrwal tank (010ST-212)	Vent line valve to be made available in critical locked open condition and tag to be provide on valve.	Mechanical	COMPLETED	5
6	CEE pure distillation reactor(011RT-042)	Pure CEE distillation in CEE pure distillation reactor(011RT-042)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	COMPLETED	6

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DIST. 2CE FROM CONTINUOUS COLUMN



3155





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HAZOP STUDY REPORT OF DRY HCL PLANT (PLANT-1)

M/S AETHER INDUSTRIES LTD.,

8203 SITE, SACHIN, SURAT

MAY 2024

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NEXA
Process Safety Engineers

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8203 SITE, SACHIN, SURAT

HAZOP STUDY REPORT OF

DRY HCL PLANT (PLANT – 1)

MAY 2024

By

NEXA PROCESS SAFETY ENGINEERS

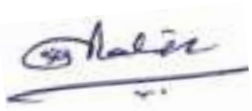
ACKNOWLEDGEMENT

We express our sincere thanks to Management and Employees of **M/s Aether Industries Ltd., Surat** for their Co-operation and unstinted help without which the HAZOP study could not have been possible. The courtesy and Cordiality extended to the HAZOP study team is highly appreciated.

We do appreciate the best planning and constant co-operation from Mr. Harshad Patel and his team and all other Head of the departments of respective plant for speedy completion of this report.

Surat





Proprietor

05-05-2024 **NEXA PROCESS SAFETY ENGINEERS**

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1.0 INTRODUCTION

A Hazard and Operability (HAZOP) study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent a risk to personnel or equipment or prevent efficient operation. A HAZOP is a qualitative technique based on "guide words" and is carried out by a multi-disciplinary team (the HAZOP Team) during one or more meetings.

The Hazard and Operability Analysis (HAZOP) technique is used to identify and evaluate safety hazards in a process plant, and to identify operability problems. Use of the HAZOP Analysis technique requires a detailed source of information concerning the design and operation of a process. High quality HAZOP analysis requires accurate up to date P&IDs, process information knowledge of process operation and instrumentation. It is most often used to analyse processes during or after the detailed design stage and also cyclic HAZOP once in every 3 years in industries. When there is change in raw material used, change in chemicals or change in work environment HAZOP is used.

The main purposes of a HAZOP are:

- To identify and evaluate hazards within a planned process or operation.
- To identify significant operating or quality problems.
- To identify practical problems associated with maintenance operation.

Traditionally HAZOPs have mainly been applied to process plants operating in continuous or batch mode. Such studies can also be applied, in modified form, to modern, electronic control and/ or protective systems and to other operations such as materials handling.

M/s Aether Industries Ltd., Surat proposed to carry out HAZOP Study for Dry HCL Plant.

Nexa Process Safety Engineers deputed Mr. Akhilkumar Patel to facilitate the HAZOP study.

The Team Leader is having a vast experience in Process Safety Management. The participants had a significant amount of experience in the Process Safety

Aspect consideration in Chemical Process Industries. Therefore, the hazards were generally well known as well as the required control measures to reduce risk to acceptable levels.

During the study, Aether's safety management system and existing site operating procedures were discussed any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures or new procedures for the facility.

2.0 SCOPE AND METHODOLOGY

2.1 Scope

The objective of the HAZOP was to identify safety concerns and improve operability situations. Management requested to carry out the HAZOP for Dry HCL Plant. It was divided in to following 5 nodes as below:

NODE NO.	NODE DESCRIPTION
1.	CaCl2 Dosing reactor(012RT-176)
2.	30%HCl CM-084 feed tank(030ST-006)
3.	CaCl2 KOD column-102(010CM-085)
4.	Distillation Column(010CM-084)
5.	Scrubber System(010TK-347)

The scope covered the identification of the safety provisions for selected deviation of the parameter, evaluation of the sufficiency of these provisions & further identifying the additional measures/ safety provisions or changes in operating procedures.

HAZOP reviews will be performed by a team who will document findings and make recommendations. They will then follow up the implementation of those recommendations.

2.2 Methodology

The HAZOP study is based on engineering line diagrams (P&ID's) and outline operating procedures. The consequences and deviations are identified, the existing safeguards are highlighted and, where necessary, appropriate corrective actions initiated.

A HAZOP study is a form of design review, which concentrates on how the plant will cope with abnormal conditions, rather than on how it will perform under normal conditions. The study comprises consideration of each process line and vessel,

examining for each the possible causes and consequences of a wide range of process abnormalities. While some of the postulated abnormalities may be inapplicable for a particular process line, they are all probed with the objective of identifying any significant route to a process upset, operating problem or hazardous incident. It is, in effect, a very thorough but mainly qualitative approach.

HAZOP is the method recommended for identifying hazards and problems, which prevent efficient operation of a processing plant. It is a technique, which provides opportunities for people to think creatively and examine all possible ways in which hazards or operating problems might arise. To reduce the chance that something is missed it is done in a systematic way - each pipeline and each type of hazard being considered in turn. The study is carried out by a team so that they can stimulate each other and build on each other's ideas.

This study was conducted through a node-by-node review, i.e., the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

1) Identify a node of the process on the P&IDs.
2) Define the design intent and normal operating conditions of the node.
3) Determine Documents referred.
4) Name the equipment covered in this node.
5) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.
6) Identify possible causes and consequences of the deviation. A deviation can be considered meaningful only if it has a credible cause and can result in harmful consequences.
7) Determine probability and severity of deviation according to risk matrix provided.
8) Rate the deviation risk level according to risk matrix.
9) Identify safeguards and required safeguards.
   Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

10) Determine action tracking for various suggested recommendations.

The results of a HAZOP depend more upon the experience and attitudes of the participants and on the leadership style adopted, than on the procedures themselves. The participants were selected to provide the necessary experience, knowledge, skills and authority to approve the actions decided upon. The Study leader needs to be very experienced in HAZOP studies and Hazard Analysis techniques and capable of performing as an independent and unbiased leader. This person needs to be familiar with other related techniques and to know when other techniques would be beneficial compared to the HAZOP technique.

3.0 PROCESS NODES

The process nodes are the locations on P&IDs, which mainly represent specific process system or units operated under the same operating condition.

Before starting the HAZOP session, the process nodes shall be determined for investigation and uniquely numbered. Node selection shall be performed by HAZOP team leader (chairman).

In case of multiple trains of identical design, only a unique single train shall be subject to the HAZOP Study in terms of generation of the HAZOP minutes, although it is obvious to apply same recommendations found in one train to the other.

Key terms that are used in the HAZOP technique or worksheet are briefly defined as follows:

Table 3.1 HAZOP Deviation Matrix

TERM	DEFINITION
NODE	The discrete location on the P&ID at which the process parameters are investigated for deviations. A node should be a discrete section of the process, which may be considered to have a specific and clear intention. It should not generally be a single equipment item, nor should it be so large and complex that it is not possible to describe the intention in a simple statement
INTENTION	Purpose of the node and intended operating state for the node.
PARAMETER	Physical or chemical property associated with the process (i.e. Temperature, pressure. flow rate reaction. etc.)
GUIDE-WORDS	Simple words which are used to qualify or quantify the intention and to guide and stimulate the process for identifying the process hazards.
DEVIATION	Departure from the design intention
CAUSES	Reasons why a deviation might occur, preferably only in the selected node
CONSEQUENCES	Effects of the deviations that may occur anywhere in the plant having many nodes.
SAFEGUARDS	Features designed to prevent the causes or mitigate the consequences of the deviations.
RECOMMENDATION	Suggestions for design changes, procedural changes, or further study.
BY	An assignment of responsibility for carrying out the recommendation

HAZOP Guidewords

PARAMETER	TYPICAL DEVIATION	EXPLANATION
Flow	No	Wrong routing, blockage, blind flange left in, faulty non- Flow return valve, burst pipe, control valve, isolation valve, pump or vessel failure.
	More	More than 1 pump operating reduced delivery head increased suction pressure, other routes, exchanger tube leaks, greater density.
	LESS	Partial blockage, vessel or valves tailing, leaks, loss of pump efficiency.
	REVERSE	As for NO FLOW, plus emergency venting, 2-way flow.
Pressure	MORE	Surge, relief, leakage from an HP connection (lines and flanges), thermal, rate of pressurizing lines.
	LESS	Generation of vacuum by pump drain out of vessels, condensation from vapour or gas dissolving in a liquid. Blocked pump or compressor suction lines.
Temperature	MORE	Fouled cooler tubes, cooling water failure, failed exchanger tubes.
	LESS	Freezing, loss of pressure, loss of heating, failed exchanger tubes.
Viscosity	MORE	Change of material, specification or temperature.
Composition	LESS	Change of material specification, or Pressure

PARAMETER	TYPICAL DEVIATION	EXPLANATION
	PART OF	Passing through isolations, leaking exchanger tubes, wrong feed material. Phase change, out of specification.
Contamination	AS WELL AS	Ingress of air, leaking isolation valves, filter failure, carry over
Relief	OTHER THAN	Relief valve, busting disk, location of discharge, bellows type, fire.
Instrumentation	OTHER THAN	Control, pressure, temperature and flow measurement: trips and testing, alarms, indicators, records, set points.
Sampling	OTHER THAN	Type, Cooling of, response time.
Corrosion and Erosion	OTHER THAN	Material specifications, fluid velocity, baffles, pipe-guides, hangers, anchors, external attack.
Service Failures	OTHER THAN	Cooling water, instruments air, steam, nitrogen or inert gas: power to machine, control circuits and computers.
Maintenance	OTHER THAN	Isolation, drainage, purging, cleaning, drying, slip plating, access, catalyst change, start-up, foundation and supports.
Outside conditions	OTHER THAN	Fire, weather, environmental change, impact, flood, etc.

RISK MATRIX

Severity		FREQUENCY				
		1	2	3	4	5
Severe	5	5	10	15	20	25
Significant	4	4	8	12	16	20
Serious	3	3	6	9	12	15
Moderate	2	2	4	6	8	10
Minor	1	1	2	3	4	5
		Frequency Description				
		Once in more than 50yr	Once in 10 to 50yr	Once in 1 to 10yr	Once a year	More than once in a year

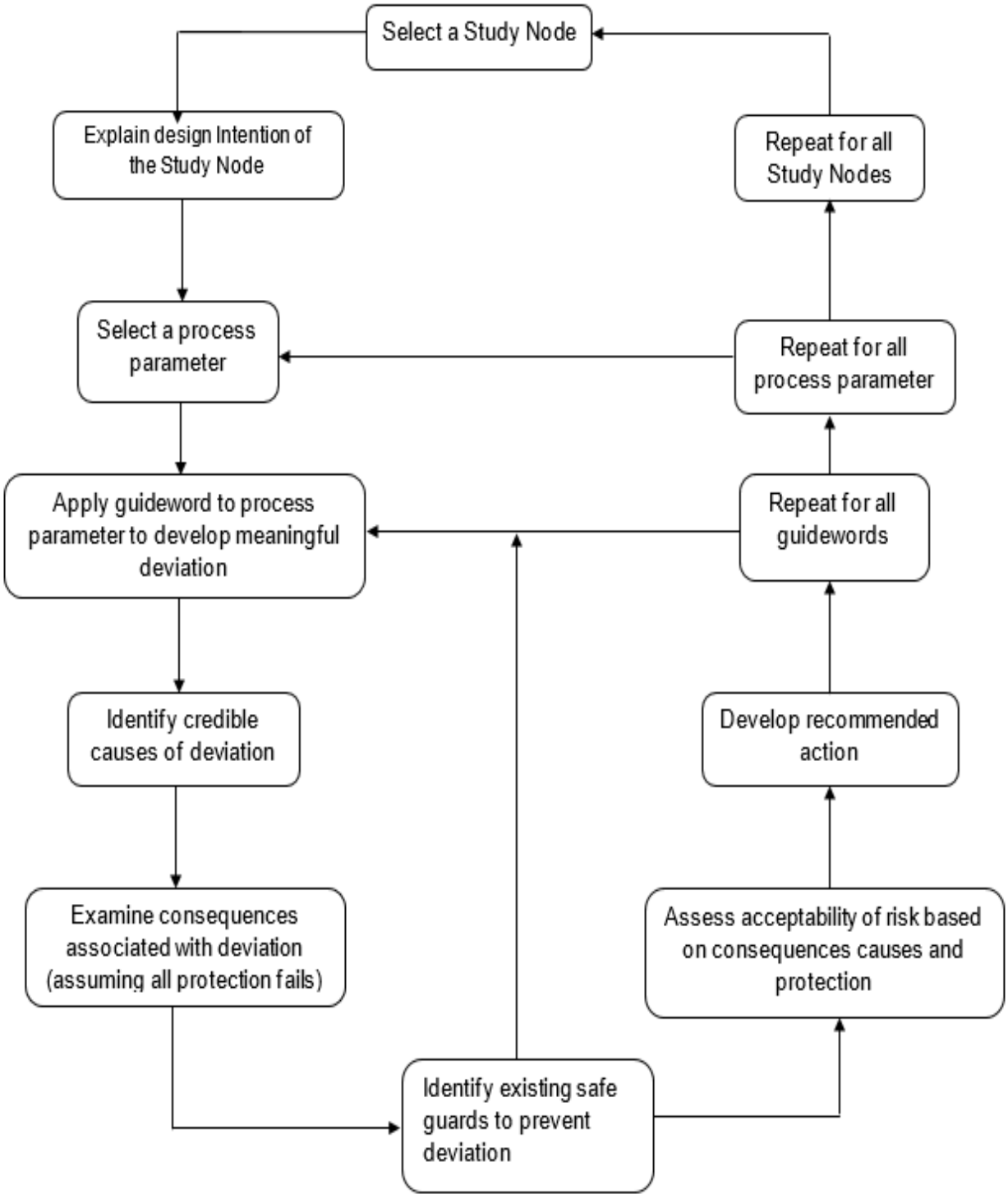
Sr. No.	Risk Rating Matrix Criteria	Risk Rating Level	Details
1.	**1- 4**	**Acceptable:** But do not forget to manage the safeguards & consequences.	A risk identified as acceptable & further reduction may not be necessary. However if the risk can be resolved quickly & efficiently. Control measures should be implemented & recorded
2.	**5- 12**	**ALARP- As low as reasonably Practicable:** Need CAPA & these actions be complied before start-up of plant.	A medium risk requires a planned approach to controlling the hazard & applies temporary measure if required. Actions taken must be documented on the risk assessment form including due for completion.
3.	**15- 25**	**Unacceptable:** Need CAPA & these are critical actions from HAZOP & to be complied before start-up of plant.	A high risk requires immediate action to control the hazard as detailed in hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
	Process safety event requiring no emergency response Activation of SIL 1 safety instrumented system	requiring site ERT response. Emergency relief device activation (utility). Activation of SIL 2 safety instrumented system	requiring external emergency response. Any Fire in areas other than mentioned in Significant category. Unintentional fire protection system activation. Emergency relief device activation (process). Activation of SIL3/4 safety instrumented system.	Process safety event resulting in temporary work stoppage (<24 hours)	or work stoppage (>24 hours). Other serious process incident (thermal runaway, vessel overpressure, or implosion, etc.)
3.+Environment – Liquid or solid spill	<5litres	100litres	≤200 litres into impervious secondary containment. No risk of soil, ground water and/or surface water contamination. No affect to site or external wastewater treatment.	200-2000 litres Localized, soil, ground water and/or surface water contamination that can be addressed without external notification or involvement. Any effect on wastewater treatment.	Any spill >2,000 litres Soil, ground water and/or surface water contamination that cannot be addressed without external notification and/or involvement.
4.Environment – vapor			GHS HH 1-2 ≤0.5kg GHS HH 3-5 ≤5kg Other GHS ≤5kg	GHS HH 1-2 0.5-5kg; GHS HH 3-5-5-100kg,	GHS HH 1-2 >5kg GHS HH 3-5 >100kg Other GHS >100kg

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
Incident Category					
1. Safety & Health	Near Miss (Low Potential)	First Aid. Reversible health effects of minimal concern Near Miss (High Potential)	Medical Treated case (Restricted Work | Lost Work) – Non-Reportable. Restricted work or transfer to another job. Medical treatment beyond first aid. Loss of consciousness. Other recordable cases. Reversible health effects of serious concern.	Lost Time Injury (Reportable) Permanent disability. Inpatient hospitalization of <3 individuals. Injury to 2 or more Individuals. Amputation. Loss of an eye. Days away from work. Non-life-threatening irreversible occupational illness (e.g. hearing loss) to one or more employees	Fatality. Inpatient hospitalization of 3 or more individuals. Potentially life-threatening irreversible occupational illness to one or more employees
2. Process Safety	Repeated activation of process alarms.	Spark (no ignition). Process safety event	Failure to inert where required as basis of safety (no ignition). Process safety event	Any Fire in process area (Process plant area, Warehouse, Lab, Power plant, Tank farms and temporary storage areas)	Deflagration /Explosion Process safety event resulting in facility evacuation , shelter in place

Severity Level	1-Minor	2-Moderate	3-Serious	4-Significant	5-Severe
to air emission			Very local impact, (e.g "fuming" from drum / vent / process areas of 50% IDLH of respective chemical) but no personal exposure	Other GHS ≤100kg Few meters dispersion, no personal exposure	Unclassified >2,000kg Any dispersion which requires any evacuation or shelter in place
5.Monetary Loss due to Property Damage / Environmental damage / Business interruption / other costs	Estimated Loss < Rs.50000/-	Estimated Loss Rs.50000 – 5 Lacs/-	Estimated Loss 5Lacs to 25Lacs	Estimated Loss 25Lacs to 50 Lacs	Estimated Loss > 50 Lacs

FLOW CHART


Select a Study Node
Explain design Intention of the Study Node
Select a process parameter
Apply guideword to process parameter to develop meaningful deviation
Identify credible causes of deviation
Examine consequences associated with deviation (assuming all protection fails)
Identify existing safe guards to prevent deviation
Assess acceptability of risk based on consequences causes and protection
Develop recommended action
Repeat for all guidewords
Repeat for all process parameter
Repeat for all Study Nodes

4.0 REFERENCED DOCUMENTS

SR. NO.	TITLE OF DOCUMENT	DRAWING / DOCUMENT NUMBER
1	P & ID / SOPS / MSDS	Provided at site

5.0 RESPONSIBILITIES

HAZOP Chairman

The HAZOP Chairman shall:

- Communicate to the HAZOP Team, the HAZOP methodology and administrative details that will be followed to ensure a successful HAZOP.
- Indicate each sub-system (nodes) on the Process P&IDs and enter the necessary data (as much as possible) in the HAZOP work sheet.
- Be responsible for the preparation, facilitation and leadership of the HAZOP study on each plant. Any dispute or problems arising during the HAZOP shall be brought to the attention of the Plant Engineer for that plant.
- Maintain accurate notes of each day's proceedings. At the end of each day, the Chairman will complete the work sheets and provide a review copy to the participants.
- Co-ordinate with the Scribe to issue the Draft and Final reports for the HAZOP Study.

Plant Manager

Each Plant Engineer is responsible for ensuring the completion of the HAZOP study, the HAZOP report and the assignment of responsibility for action items for his respective plant. The Plant Engineer shall:

- Ensure that all documents required for the HAZOP are available prior to the commencement of the meeting.

- Note: hard copies of all documents may not be required, provided that suitable electronic access is provided.
- Be available for all the HAZOP meetings for his plant and shall deal with any disputes and problems arising during the HAZOP studies. It is not necessary for the Plant engineer to attend full time.
- Action all HAZOP study results (except for those deemed inappropriate and agreed), per the procedure set forth.

Process Engineer

The HAZOP team shall include at least one Process Engineer who shall:

- Be intimately familiar with the process (if applicable) and control system.
- Provide process and control expertise as required.
- Review the HAZOP minutes for completion at the end of each day and provide relevant comments.

Scribe

The scribe shall as a minimum be a graduate engineer, who will attend the meetings full time His \her duties shall include the following:-

- Ensure that work sheet is loaded and functioning properly on the PC, and familiarize him/her with all computers.
- Prepare skeleton HAZOP reports for each process plant. This activity should be performed prior to the commencement of the HAZOP.
- Assist the Chairman with indicating sub-systems (nodes) on the process P&IDs.
- Maintain accurate notes for each meeting day. At the end of each day, assist in the completion of the worksheets.
- Prepare a draft report per the Table of Contents and format as described in Appendix B. This report will be submitted for approval within one week of completion of the HAZOP.
- Incorporate comments and issue the Final Report, within ten (10) working

days of the completion of the plant HAZOP.

- Familiarize him/her with the key documents to be used for the HAZOP.

Discipline Engineer

The Discipline Engineers shall attend the HAZOP meetings and provide information, as requested, within their fields. This shall include, but not be limited to, the following disciplines:

- Instrumentation
- Electrical
- Piping
- Mechanical and Rotating Equipment

Other Representative (Where Applicable)

The client representative shall provide process, control and system expertise for all units during the HAZOP.

- Have sufficient operational experience to identify potential hazards and to recommend appropriate measures for mitigation.
- Review the HAZOP report and responsibility matrix prior to their being issued.

6.0 STUDY TEAM

All the team participants had the appropriate level of experience in design and/or operation of Chemical plants. Table shows the team members who participated throughout the HAZOP study.

The opening meetings were led by Mr. S G Patel as recorded on the HAZOP study record sheets.

SR. NO.	NAME	DISCIPLINE	COMPANY
1.	Mr. Akhilkumar Patel	HAZOP Leader	Nexa Process Safety Engineers
2.	Mr. Smit Desai- Process Safety Mr. Chetan Panchal- Electrical Mr. Kalpesh Patel- Production Mr. Parag Detroja- Mechanical Mr. Harshad Patel- Safety	HAZOP Team Members	M/s Aether Industries Ltd., Surat

7.0 RECOMMENDATION/SPECIFIC REMARKS

All recommendations and actions will be monitored and tracked using an excel spread sheet which will indicate person responsible for action and target date. Where an action has been implemented, its status will be shown as 'closed'. It is expected that all engineering related actions will need design, procurement and installation. Detailed schedule of sub activity will help to monitor the tracking and progress. While actions that can only be implemented during shut down or shut down of common utilities. The status of all recommendations transferred to the HSE Action Tracking Register will be shown as 'pending'.

Responding to HAZOP Recommendations by management

The objective of the HAZOP session was to raise hazards or operability issues, not to solve any problems. Therefore the recommendations generated have been worded in a general manner using words like 'Confirm', 'Consider', 'Develop', 'Add', 'Ensure' and 'Review'; see below for detailed description. It should be noted that the responses to the HAZOP recommendations should provide a clear audit trail including the reasons for taking or not taking action.

"...Confirm... 'Confirm is used when the HAZOP team believe something to be true, but have been unable to check this during the HAZOP meeting. However, if the situation is at all different from what the HAZOP team have assumed then it is likely that some action is necessary to address the hazard or operability point raised. In that case the action that will be taken and the reason (including justification for no action if this is the outcome) must be included in the response.

"...Consider..." Consider is used where the HAZOP teams believe that some action may be necessary, but there is some uncertainty as to precisely what is required, or whether action is reasonably practicable, or may have other unacceptable consequences. The response should outline the options considered and the conclusions reached, including justification for the action (including no action) taken.

"...Develop..." Develop is typically used where the HAZOP team believe that specific operating procedures are required or where an unusual operating mode requires definition, but could also be used in other similar situations. The response would not normally be the procedure or operating mode definition itself, but either a reference to the document containing the procedure or mode definition or how the required action will be transmitted to a responsible party for future implementation.

"...Add..." The HAZOP team is convinced that something needs to be done to address a particular hazard or operability point, and will typically include a specific recommendation. If the recommended action is not taken, then it would normally be expected that some more effective alternative would be used. In any case the action taken should be clearly outlined and justified in the response.

"...Ensure..," Ensure is generally used as a reminder to include a particular point in documents, such as Cause and Effects, which may not have been ready at the time of the HAZOP. Where the document is issued prior to HAZOP closeout the response should include a note of precisely what has been done. If the document will not be issued until after HAZOP close-out, then the response should indicate how the point will be transmitted for future implementation.

“...Review..." Review is used where the HAZOP team has a concern, but where there is a relatively high uncertainty about the details of the concern or on the best means to address the concern. The response should cover the options reviewed, the conclusions of the review and the details of the actions taken, or justification for no action.

8.0 CONCLUSION

The HAZOP teams assembled for the study were well balanced in terms of disciplines and experience. The team sizes were generally kept to the required four to six people. This increases the ability to achieve a creative brainstorming workshop to help ensure maximum effectiveness and quality.

Any significant changes to the HAZOP design should be separately assessed for new potential hazardous events and operability problems. This is commonly achieved by utilising a management of change programme within the project.

During the study, the safety management system and existing site operating procedures were discussed. Any significant issues identified have been recorded in the HAZOP minutes for inclusion in the final version of the updated procedures for the facility.

The details of process were systematically reviewed and the study was performed and recorded. Deviations in each node has been assessed using various guide words to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as “Intolerable” “Substantial” “Moderate” “Tolerable”” Trivial”.

The decisions made by the HAZOP team members are based on their experience and knowledge of the type of processing plant under review. If the HAZOP team members determined the existing control measures were adequate then no further action is required. Significant points of discussion (generally, if significant consequential impacts are possible) were recorded even though the control measures were deemed acceptable by the HAZOP team. All issues requiring a response were included in the HAZOP minutes.

The actions recorded during the study were mostly in the design or “improved

operability and maintainability" categories. There were no previously unidentified potential hazardous events with significant off-site impact determined. Please refer to column entitled "Action Tracking" in the HAZOP minutes for details of the recorded actions in Appendix 1.

Completed HAZOP actions need to be tracked within the project's HAZOP action register or equivalent. Regular project meetings should include a review of the progress of closing-out all of the actions. It is normally the responsibility of the project manager to ensure that all of the HAZOP actions are completed.

The HAZOP drawings and a record of the completed actions should be retained with the plant files.

9.0 REFERENCES

1. "A Guide to Hazard and Operability Studies" - Published by Chemical Industries Association.

2. IEC 61882— Guide to Hazard and Operability Studies.

10.0 DISCLAIMER

NEXA Process Safety Engineers prepared this report as teamwork for **M/s Aether Industries Ltd., Surat**.. The material in it reflects NEXA PSE's best judgment and experience of the HAZOP team member as in the light of the information available to them at the time of preparation. However, as NEXA PSE cannot control the conditions under which this report may be used, NEXA PSE will not be responsible for damages of any nature resulting from use of or reliance upon this report. Therefore, process & engineering concepts shall be applied for implementing the recommendation. NEXA PSE's responsibility for advice given is subject to the terms of engagement with **M/s Aether Industries Ltd., Surat**.

APPENDIX-1: HAZOP MINUTES

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Water charging in CaCl2 Dosing reactor(012RT-176)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	No HSE hazard	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow.	2	2	4				
			Line leakage	No HSE hazard	-							
			No level in Soft water tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow.	3	3	9				
			Human error (Vent line valve not opened)	Reactor may pressurize	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in reactor to monitor the pressure of the reactor. 3.Reactor design pressure is upto 6 bar.	3	4	12	1. Vent line valve should be locked open with tagging.	2	4	8
			Flow meter malfunction	No HSE hazard	Flowmeter PM is performed before start-up.	3	2	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	No HSE hazard	1.Trained man power is deputed for DCS operation. 2.Upper limit of totaliser is freeze as per process requirement. 3.Interlock is provided to close the water transferring line ROV at set value achieved in totaliser.	3	2	6				
			Flow meter malfunction		1.Flow meter PM is performed as per predefined schedule.	3	2	6				
		Reverse	No probable cause									
		Mis-directed flow	Manual valve pass	No HSE hazard	1. Double manual valve is available.	2	2	4				
2	Pressure	Low	No probable cause									
		High	Human error (Vent line valve not opened)	Reactor may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PG is available in reactor to monitor the pressure of the reactor.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					3.Reactor design pressure is upto 6 bar.							
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Reactor Bottom valve left open/pass	No HSE hazard	Trained manpower and SOP is available before line up.	2	3	6				
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6				
			Reactor leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
			Jacket puncture of the reactor	Reactor may overflow and material incompatible hazard may possible	1.Before startup spark test & thickness testing is performed. 2.Compatible utility is used in jacket of the reactor.	3	3	9				
5	Composition	Other than	No probable cause	No HSE hazard								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Reactor may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Water transferring line XV air failed safe position is to be air failed to closed condition .	3	3	9				
		Power Failure	-	No HSE hazard								
		DCS Failure	-	No HSE hazard								
		Agitation	-	No HSE hazard								
Stream-2		**CaCl2 charging in CaCl2 dosing reactor(012RT-176)**										
7	Quantity/Flow	No/Less	Human error (Less quantity of CaCl2 charged)	No HSE hazard/Process Delay	Batch wise fix charging quantity of material will be issued from the store to prevent human error.	3	1	3				
		High/More	Human error (More quantity of CaCl2	No HSE hazard/Process Delay	Batch wise fix charging quantity of material will be issued from the store	3	1	3				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			charged)		to prevent human error.							
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	No probable cause									
			No probable cause									
9	Temperature	Low	No credible cause									
		High	Human error(Material is charge by more rate)	Temperature rise may be possible in the dosing reactor	1.Trained manpower is deputed for operation. 2.TI is available in the reactor with high and high high alarm. 3.Cooling water supply provision is available in the dosing reactor. 4.Flash alarm is provided on HH value of TI of the reactor.	3	4	12				
10	Level	Low	Refer low									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 1		**Node Description : CaCl2 Dosing reactor(012RT-176)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Flow									
		High	Refer high Flow									
11	Composition	Other than	Wrong material supplied from store	Material incompatibility hazard may arise	1.Material issue slip is verified by plant person. 2.Checklist is filled and verified by product person and ensure actual material is charged in process.	3	3	9				
12	Others	Static charge	No credible cause									
		Leakage spillage		No HSE hazard								
		Instrument Air failure	No probable cause									
		Power Failure	GEB failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	GEB failure	No HSE hazard	Battery bank backup is provided and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Temperature rise may be possible in the dosing reactor	1.Agitator running indication is provided on DCS. 2.No load tripping is provided on agitator.	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**30%HCl charging in CM-084 feed tank(011TK-318) from storage tank(030ST-006)**										
1	Quantity/Flow	No/Less	Human error (Discharge valve not opened).	Line may pressurise	1.Trained manpower is deputed. 2. Flowmeter is available in the line to ensure flow. 3.Line pressure testing is done before start up.	2	2	4				
			Transferring pump stop/trip	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.	2	1	2				
			Line leakage	Health hazard due to spillage	1.Line pressure testing is performed before start up. 2.Spillage kit is provided in nearby area.	2	2	4				
			No level in HCl tank	No HSE hazard	1. Flow meter is available in the line to monitor the flow. 2.LI is available in tank.	3	1	3				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High/More	Human error (Wrong input in totaliser)	Receiver may overflow	1.Trained manpower is deputed for operation 2.LI is available in receiver with high and high high alarm. 3.upper limit of totaliser is freeze for HCL. 4. Interlock is provided to stop the transferring pump and closed transferring line XV at HH value of LI of the receiver. 5.Flash alarm is provided on HH value of LI of the HCL storage receiver.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
		High	Human error (Vent line valve not opened)	Receiver may pressurise	1. SOP is available to open vent valve before starting transferring activity. 2. PT is available in the reactor with high and high high alarms. 3. Interlock is provided to closed charging line XV & transferring pump to be stop at HH pressure of receiver.	3	4	12	1. Vent line valve should be locked open.	2	4	8
3	Temperature	Low	No probable cause	No HSE hazard								
		High	No probable cause	No HSE hazard								
4	Level	Low	Receiver Bottom valve left open/pass	Health hazard due to spillage	1.Trained manpower and SOP is available before line up. 2.Double manual valve available at bottom of the receiver.	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Line leakage		1. Line testing done before start-up. 2. Compatible gasket is used.	2	3	6	1. Flange guard to be provided on all flanges. 2. Spill kit to be provided at nearby area to contain the spillage.			
			Receiver body leakage		PM is performed before start-up and record is maintained.	2	3	6				
		High	Refer High/More flow									
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	Not applicable									
		Instrument Air failure	Air compressor failure	Receiver may overflow	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Transferring line XV air failed safe position is to be air failed to closed condition.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard/Process								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 2		**Node Description : 30%HCl CM-084 feed tank(030ST-006)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
				Delay								
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay								
		Agitation	Not applicable	No HSE hazard/Process Delay								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**CaCl2 transfer in cacl2 KOD column(010CM-085) by cacl2 dosing tank (012RT-176) by gravity**										
1	Quantity/Flow	No/Less	Line leakage	Health hazard due to spillage	1. Line pressure test is performed before start-up. 2.Spill is provided in the nearby area.	3	3	9	1. Flange guard to be provided in all the flanges.			
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
2	Pressure	Low	No probable cause	No HSE hazard								
		High	Human error(Manual vent line valve is not open of column)	column may pressurise	1.Vent is provided in column & ensure before startup that valve is open condition. 2.column design pressure is 6 bar. 3.Trained manpower will operate the operation. and ensure valve position before start operation.	3	4	12	1.Vent line/vapour line valve should be always locked open condition with tag.	2	4	8
3	Temperature	Low	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may be possible in the column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in column with high and high high alarm. 5.Flash alarm is provided on HH value of RTD of the column.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
4	Level	Low	column Bottom valve left open/pass	Health hazard and fire hazard may possible	1.Trained manpower and SOP is available before line up. 2.Double manual bottom valve is provided in column.	3	3	9				
			Line leakage		1. Line testing done before start-up. 2. Compatible	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					gasket(Teflon) is used.							
			column body leakage	Incompatible hazard may possible	1.PG is available in utility return line. 2. PM testing of column is performed periodically.	3	3	9				
		High	Jacket puncture	Overflow from column and lead to spillage/health hazard	1. Jacket PM is performed before start-up. 2. Utility media is compatible with the reaction mass.	2	3	6				
5	Composition	Other than		No HSE hazard								
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided, and PM is done for the same periodically.	3	1	3				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Agitation	Not Applicable									
Stream-2		**Heating in CaCl2 KOD column(KOD-102) through thermo siphon reboiler(HE-105)**										
7	Quantity/Flow	No/Less	Refer low flow of stream 1	-	-				-			
		High/More	Refer high flow of Stream 1	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
8	Pressure	Low	No probable cause	-	-				-			
		High	TCV failure/stuck open	column may pressurise	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.Vent is provided in column & ensure before startup that valve is open condition. 5.PM of TCV is carried out as per predefined	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					schedule.							
			Human error(Manual vent line valve is not open of column)		1.Trained manpower will operate the operation. and ensure valve position before start operation.	3	4	12				
9	Temperature	Low	No probable cause									
		High	TCV failure/stuck open	Temperature rise may be possible in column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in column with high and high high alarm. 5.PM of TCV is carried out as per predefined schedule. 6.Flash alarm is provided on HH value of RTD of the column.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					7.Upper limit of TCV set value is freeze as per process requirement.							
			Human error(Wrong temperature set point is given in TIC(temperature indicator & controller))		1.RTD is provided in the column with high and high high alarms. 2.Trained manpower is deputed for DCS operation. 3.Interlock is provided to close the steam TCV at HH value of TI of column.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
			TI malfunctioning of column		1.TI is provided in utility supply & return line.	3	4	12				
10	Level	Low	Line/Flange leakage	Health hazard due to spillage	1.Flange guard is provided on the flanges. 2. Suitable PPE's are available. (Goggles, Face shield, Hand gloves (Acid resistant) 3.Line pressure test is performed before start up. 4.150 class flange is used.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : CaCl2 KOD column-102(010CM-085)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					5.Compatible gasket is used prevent gasket leakage.							
			column bottom valve passed		1.Compatible MOC of valve is used at bottom of the column. 2.Double manual valve is provided at bottom of the column.	3	3	9				
			column Leakage		1.column MOC is compatible with material. 1.column thickness testing is performed on quarterly basis as per PM schedule.	3	3	9				
		High	No probable cause									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	column may pressurise & Exotherm may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.TCV of steam line air failed safe position to be air fail to close.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided, and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decoupled due to mechanical failure	Runaway may possible	1.No load tripping is provided on agitator. 2.Steam TCV is closed in case of agitator stop/trip.	3	4	12				
Stream-3		**Hot CaCl2 solution transfer in distillation column by gravity**										
13	Quantity/Flow	No/Less	Line leakage	Health hazard due to spillage	1. Line pressure test is performed before start-up.	3	3	9				
			Drain point valve open/passed	Health hazard due to spillage	1.Trained manpower is deputed for operation and ensure proper lineup before startup. 2.Recommend to provide dual manual valve/blind at drain point/sample point.	3	3	9				
		High/More	No probable cause									
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable	No HSE hazard								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
		High	Human error(Manual vent line valve is not open of distillation column)	column may pressurise	1.Vent is provided in column & ensure before startup that valve is open condition. 2.Trained manpower will operate the operation. and ensure valve position before start operation. 3.2 no of PT is available on column with high and high high alarm. 4.RD is also provided in distillation column. 5.PSV is also provided in distillation column. 6.Flash alarm is provided on HH value of PT of the distillation column.	3	4	12				
15	Temperature	Low	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		High	TCV failure/stuck open	Temperature rise may be possible in the column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.RTD is available in column with high and high high alarm. 5.Flash alarm is provided on HH value of RTD of the column.	3	4	12				
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure proper lineup before startup.	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8
16	Level	Low	Refer low flow									
			Column body leakage	Health hazard due to spillage	1.PM of distillation column and pressure test is performed before startup and as per predefine schedule.	3	3	9				
		High	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
17	Composition	Other than		No HSE hazard								
18	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	No HSE hazard/Process Delay	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available.	3	1	3				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided, and PM is done for the same periodically.	3	1	3				
		Agitation	Not Applicable									
Stream-4		**Aqueous collection in aqueous storage tank HCL plant(010ST-223) from condenser**										
13	Quantity/Flow	No/Less	Line/Flange leakage	Health hazard may possible due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.150 class flange is used. 4.Flange guard is provided on the flanges.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Human Error (Manual valve of material collection line on tank is not open)	No HSE hazard/Process Delay	1.Trained manpower will be deputed for operation and verified valve position before startup. 2.LI is available in aqueous tank to monitor the level of the tank.	3	1	3				
			Sample point/Drain point manual valve pass	Health hazard due to spillage	1.Trained manpower will be deputed for operation and verified valve position before startup. 1.Double valve/blind is provided to prevent valve passing/leakage.	3	3	9				
			No/low level in CaCl2 KOD column	No HSE hazard/Process Delay	1.Manual LI is provided in the KOD column.	2	1	2				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in condenser	health hazard may possible	1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line of primary condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE flash alarm to be provide.	3	3	9				
			Top collection line CV stuck	No HSE hazard								

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : CaCl2 KOD column-102(010CM-085)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(vent line manual valve is not open)	Tank may pressurize	1.Trained man power is deputed for operation and ensure proper lineup before startup. 2.PT is available in aqueous tank with high and high high alarm. 3.Aqueous tank is design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the aqueous tank.	3	4	12	1.Vent line valve should be critically locked open condition with tagging.	2	4	8
			Heating stopped	No HSE hazard/Process Delay	1.Steam TCV indication is available on DCS.							
		High/More	Tube leakage in condenser	1.Material incompatible hazard 2.Tank may overflow	1.Pressure test is performed before start-up. 2.LI is available with high and high high alarms. 3.Compatible utility is used in condenser .so, there are no chances of incompatibility hazard. 4.Flash alarm is provided on high high value of LI of aqueous tank.	3	3	9				

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P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 3		Node Description : CaCl2 KOD column-102(010CM-085)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(Steam TCV more percentage open in thermosiphon reboiler)	Pressure rise may be possible in column	1.Trained manpower is deputed for DCS operation. 2.Steam TCV percentage opening indication is available on DCS.	3	3	9				
		Reverse	No probable cause									
		Mis-directed flow	No probable cause									
14	Pressure	Low	No probable cause									
		High	Human error(vent line manual valve is not open)	Tank may pressurize	1.Trained man power is deputed for operation and ensure proper lineup before startup. 2.PT is available in aqueous tank with high and high high alarm. 3.Aqueous tank is design pressure is upto 6 bar. 4.Flash alarm is provided on HH value of PT of the aqueous tank.	3	4	12				
15	Temperature	Low	No probable cause									
		High	No probable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 3		**Node Description : CaCl2 KOD column-102(010CM-085)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
16	Level	Low	Tank leakage	Health hazard due to spillage	1. Aqueous tank design pressure is upto 6 bar. 2. Pressure test is performed before start-up. 3. LI is available in the with low and low low alarms. 3.Equipment thickness testing is carried out as per define schedule.	3	3	9				
			Bottom valve pass/leakage		1.Double valve is available to prevent valve passing/leakage.	3	3	9				
		High	Refer high Flow									
17	Composition	Other than	No probable cause									
18	Others	Static Electricity	-	Fire hazard	1. Double earthing is provided to column. 2. Earthing continuity is verified before start-up. 3.Fire hydrant points& fire extinguisher are available in nearby area. 4.All electrical equipment are flameproof in nearby area.	3	3	9				
		Instrument Air failure	Air compressor failure	No HSE hazard/process								

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Node 3		Node Description : CaCl2 KOD column-102(010CM-085)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
				delay								
		Power Failure	GEB power failure	No HSE hazard								
		DCS Failure	Battery bank failure	No HSE hazard								
		Agitation	Not applicable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream-1		**Heating , maintaining and CaCl2 circulation in distillation column(010CM-084)**										
1	Quantity/Flow	No/Less	CaCl2 Circulation pump trip/stops	No HSE hazard/Process Delay	1.Circulation pump running indication is available on DCS.	3	1	3				
			Human error (Discharge manual valve not opened).	Transferring line may pressurise	1. Trained manpower will be deputed for operation. 2.Line design pressure is sustained to resist maximum discharge pressure of pump.	4	3	12				
			Line leakage	Health hazard due to spillage	1.Line pressure test is performed before startup. 2.Compatible gasket is used. 3. Flange guard is provided on all flanges.	3	3	9				
			Line chocked	Line may pressurise	Material having no choking	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					property.							
		High/More	No probable cause	-	-				-			
		Reverse	No probable cause	-	-				-			
		Mis-directed flow	No probable cause	-	-				-			
		Low	No probable cause									
2	Pressure	High	TCV failure/stuck open	Pressure rise may be possible in the column	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure & bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PT is available in reactor with high and high high alarm. 5.Manual valve is available in line of steam TCV.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in primary condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary and secondary to tertiary condenser line.	3	3	9				

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Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					6.TI is provided in final vent line connected with knockout drum. 7.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE respectively steam TCV and HCl feeding line FCV to be closed. 8.Interlock is provided to closed steam TCV at HH pressure of the distillation column.							
3	Temperature	Low	No probable cause									

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P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		High	TCV failure/stuck open	Temperature rise may possible	1.PM is performed of TCV before start up. 2.Bypass loop is available in case of TCV failure bypass procedure will be followed. 3.TCV indication is available on DCS with percentage. 4.PM of TCV is performed before start operation. 5.Five numbers of TI is provided in distillation column with high and high high alarm.	3	4	12				

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P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error(TCV bypass line passed/open)		1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.Five numbers of TI is provided in distillation column with high and high high alarm. 3. Flash alarm is provided at HH temperature of bottom and top of the column.. 4. Interlock is provided to close steam line TCV at HH temperature of top and bottom of the column. 5. Interlock is provided to close steam line TCV at HH temperature of	3	4	12	1.TCV bypass valve should be locked closed condition with tagging.	2	4	8

HAZOP study of Dry HCL project at 8203 site												
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Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					the final vent/vapour line of TI. 6.Flash alarm is provided on HH temperature of final vent/vapour line of reactor.							
			TI malfunctioning of reactor		1.TI is provided in utility supply & return line. 2.PM of critical instrument is done as per pre-defined schedule. 3.Five number of TI is provided in distillation column.	3	4	8				

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Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
4	Level	Low	Column body leakage, Bottom valve pass/leakage	1.Gas/Liquid Exposure due to spillage	1.Pressure testis performed before startup. 2.PM of distillation column is performed as per predefine schedule. 3.Manual LI is available in distillation column to monitor the level of distillation column. 4.LI is available in distillation column with indication on DCS.	3	3	9				
		High	Condenser leakage	Column may overflow	1.Before start process hydro test of condenser is performed. 2.LI is available in column with high and high high alarm.	3	3	9				

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Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
5	Composition	Other than	No probable cause									
6	Others	Static Electricity	No probable cause									
		Instrument Air failure	Air compressor failure	Temperature rise may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of steam TCV is air failed to closed condition.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided, and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									
Stream-2		**Continuous feeding from HCl receiver(011TK-318) to distillation column(010CM-084) through feeding pump (010TP-321)**										

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Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
7	Quantity/Flow	No/Less	Feeding pump trip/stop	No HSE hazard/Process Delay	1.Pump running indication is available on DCS.							
			Line/Flange leakage	Health hazard due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.150 class flange is used.	3	3	9	1.Flange guard to be provide on the flanges.	2	3	6
			Human Error (Manual valve in pump discharge line and feeding line of column is not opened)	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower is deputed for operation and ensure valve operation before start-up. 3.Inbuilt PSV is available in the pump.	3	3	9				

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Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Sample point/Drain point manual valve pass	Health hazard due to spillage	1.Trained manpower is deputed for operation and ensure valve is open before startup. 2.Double valve/blind provision to prevent valve passing/leakage.	3	3	9				
			No/low level in receiver	No HSE hazard/Process Delay	1.LI is available in receiver to monitor the level of the receiver.							
			Flow meter malfunctioning/Chocked	Transferring line may pressurize	1.PG is available in discharge line of feeding pump. 2.Trained manpower will be deputed for operation and ensure valve operation before start-up. 3.Material have no chocking property. 4.PM of flow	2	3	6				

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P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					meter to be performed before startup.							
		High/More	Human error (Feeding pump run with full capacity)	1.Flooding may be possible in column/Process Delay 2.Pressure rise may possible in column	1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	4	12				

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Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Wrong input set in HCL feeding line FCV)		1.Trained manpower is deputed for DCS operation. 2.Two number of PT is available in column with high and high high alarm. 3.Rupture disc with catch pot is also provided in distillation column. 4.Safety valve is also provided in distillation column. 5.Upper limit of set point of hcl feeding line flow meter is freeze. 6.Flash alarm is provided on HH value of both PT of the distillation column.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 4		**Node Description : Distillation Column(010CM-084)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
		Reverse	Pump trip/stops	Pump mechanical damage	Inbuilt NRV is available in pump.	2	3	6				
		Mis-directed flow	No probable cause									
8	Pressure	Low	No probable cause									
		High	HCl feeding line FCV failure/stuck open	1.Flooding may be possible in column/Process Delay 2.Pressure rise may possible in column	1.PM is performed of FCV before start up. 2.Bypass loop is available in case of FCV failure & bypass procedure will be followed. 3.FCV indication is available on DCS with percentage. 4 Two numbers of PT is available in column with high and high high alarm. 5.Manual valve is available in	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					line of HCl feeding line FCV.							
			Human error (Feeding pump run with full capacity)		1.Mass flow meter with totaliser is available in feeding line with high and high high alarm. 2.PG is available in feeding pump discharge line. 3.LI is available in sump of the column with high and high high alarms. 4.Feeding line flow meter upper limit is freeze. 5.PM of feeding pump is carried out as per define frequency. 6.Flash alarm is provided on high high value of LI of column.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Human error (Wrong input set in HCL feeding line FCV)		1.Trained manpower is deputed for DCS operation. 2.Two number of PT is available in column with high and high high alarm. 3.Rupture disc with catch pot is also provided in distillation column. 4.Safety valve is also provided in distillation column. 5.Upper limit of set point of hcl feeding line flow meter is freeze. 6.Flash alarm is provided on HH value of both PT of the distillation column.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			PCV stuck of final dry HCL gas line/ pressure control valve of column		1.PM is performed of PCV before start up. 2.Bypass loop is available in case of PCV failure & bypass procedure will be followed. 3.PCV indication is available on DCS with percentage. 4 Two numbers of PT is available in column with high and high high alarm. 5.Manual valve is available in line of final PCV. 6.PT is available in line of final PCV with high and high high alarm.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			Title : HAZOP study of Dry HCL project at 8203 site						Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
			Utility failure in condenser		1.TI is provided in utility supply & return line of the condenser with high and high high alarms. 2.Flow meter is provided in cooling water supply line in primary condenser. 3.Cooling water circulation pump indication is also available on DCS. 4.PT is also available in cooling tower pump discharge line with low and low low alarms. 5.TI is provided in vapour line from primary to secondary and secondary to tertiary condenser line.	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
					6.TI is provided in final vent line connected with knockout drum. 7.Interlock is provided that at LL value of flow meter in cooling water supply line in PHE HCl feeding line FCV to be closed. 8.Interlock is provided to closed HCl feeding line FCV at HH pressure of the distillation column.							
9	Temperature	Low	No probable cause									
		High	No probable cause									
10	Level	Low	Refer low Flow									
		High	Refer high Flow									
11	Composition	Other than	No probable cause									
12	Others	Static Electricity	No probable cause									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		Title : HAZOP study of Dry HCL project at 8203 site							Plant Name: Plant-1			
Node 4		Node Description : Distillation Column(010CM-084)										
Sr. No.	Process Parameter	Guide word	Probable Cause	Consequence	Existing Safe guards	F	S	R	Recommendations	F	S	R
		Instrument Air failure	Air compressor failure	Column may pressurise	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of HCL feeding FCV is to be air failed to closed condition.	3	4	12				
		Power Failure	GEB power failure	No HSE hazard/Process Delay	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard/Process Delay	Battery bank backup is provided, and PM is done for the same periodically.	3	1	3				
		Agitation	Not applicable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
Stream -1		**Reaction in scrubber tank (010TK-347)**										
1	Quantity/Flow	No/Less	Circulation pump stop/trip	Chances of gas exposure from vent line	1.Pump running indication is available on DCS . 2.Vent line of scrubber column is dipped into vent pot. So, less chances of gas exposure. 3.Flash alarm is provided on trip/stop of scrubber circulation pump. 4.Interlock is provided to stop HCl feeding pump and closed feeding line FCV incase of circulation pump stop/trip. 5.Interlock is provided to closed the steam TCV of both thermosyphon reboiler of KOD column and distillation column	3	3	9				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					respectively.							
			Line/Flange leakage	Gas/Liquid exposure due to spillage	1.Compatible gasket is used to prevent gasket leakage. 2.Line pressure test is performed before start up. 3.Spill kit is provided in nearby area to contain spillage. 4.Flange guard is provided on the flanges.	3	3	9				
			Human Error (Pump Discharge Valve not opened)	Transferring line may pressurise and can lead to spillage/health hazard	1.Line is designed to resist maximum discharge pressure of pump to prevent line pressurisation. 2.PG is available in the discharge line to monitor pressure. 3.Trained manpower will perform charging activity and ensure valve operation before start-up.	3	3	9	1.Pump discharge valve should be critical locked open condition and tag to be provide on that.	2	3	8

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Sample point/Drain point manual valve pass	Gas/Liquid Exposure due to spillage	1.Trained manpower is deputed for operation and ensure proper line up before start up. 2.Double valve is provided to prevent valve passing/leakage.	3	3	9				
			NRV chocked in pump discharge line	Transferring line may pressurise and can lead to spillage/health hazard	Compatible MOC of NRV is used so chocking not possible.	2	3	6				
		High/More	Jacket puncture in graphite absorber	Scrubber tank may overflow	1.Pressure test is performed of absorber before startup. 2.LI is available in scrubber tank with high and high high alarm. 3.Flash alarm is provided on HH value of LI of scrubber tank.	2	3	6				
			Jacket puncture of the scrubber tank		1.Pressure test is performed of scrubber tank . 2.LI is available in	2	3	6				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					scrubber tank with high and high high alarm. 3.Spark test of scrubber tank is performed before startup.							
		Reverse	Pump trip/stops	Pump mechanical failure	NRV is available in the pump discharge line to prevent reverse flow.	3	2	6				
		Mis-directed flow	No probable cause	-	-				-			
2	Pressure	Low vacuum	Venturi chocked of circulation line	vacuum drop in scrubber tank	1.Material having no choking property. 2.Before startup it is verify that venturi is clean.	3	2	6	-			
		High	Human error(Vent line valve of final scrubber tank is not open)	Scrubber tank may pressurise	1.PT is available on the final tank with high and high high alarms. 2. Trained manpower will perform the operation. 3. Scrubber tank design pressure is up-to 6bar.	3	4	12	1. Vent line manual valve to be in critical locked open condition with LO tag.	2	4	8

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22			**Title : HAZOP study of Dry HCL project at 8203 site**						**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					4.PT is available in scrubber tank with high and high high alarm. 5. Flash alarm is provided on HH alarm value of PT of final scrubber tank. 6.Flash alarm is provided on HH alarm value of PT of scrubber tank. 7.Interlock is provided to stop the feeding pump of HCl and FCV of feeding line at HH pressure of scrubber tank and final vent pot.							
			Human error(Vent line valve of intermediate scrubber tank is not open)	Intermediate scrubber tank may pressurise	1.PT is available on the intermediate scrubber tank with high and high high alarms. 2. Trained manpower will perform the operation and ensure valve is open before startup. 3. Scrubber tank	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
					design pressure is up-to 6bar. 4.Flash alarm is provided on HH value of PT of intermediate scrubber tank. 5.Interlock is provided to stop the feeding pump of HCl and FCV of feeding line at HH pressure of intermediate scrubber tank.							
3	Temperature	Low	No credible cause	-	TI is available in receiver with low and low low alarms							
		High	Utility failure in jacket of the tank	Temperature rise may possible in scrubber tank	1.TI is available in scrubber tank with high and high high alarms.	3	4	12				

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			Utility failure in jacket of the absorber		2.TI is available in utility supply and return line of scrubber tank with alarms. 3.TI is available in utility supply and return line of graphite absorber. 4.Utility circulation pump indication is provided on DCS. 5.Flash alarm is provided on HH value of TI of the scrubber tank.							
4	Level	Low	Refer low Flow									
		Low level in tank	Tank body leakage	Gas/Liquid Exposure due to spillage	1.Receiver MOC is compatible, so leakage is not possible 2.LI is provided in scrubber tank with low and low low alarm.	2	3	6				
		High	Refer high Flow									
5	Composition	Other than	No probable									

HAZOP study of Dry HCL project at 8203 site												
P&ID of GL/36422/22		**Title : HAZOP study of Dry HCL project at 8203 site**							**Plant Name: Plant-1**			
Node 5		**Node Description : Scrubber System(010TK-347)**										
Sr. No.	**Process Parameter**	**Guide word**	**Probable Cause**	**Consequence**	**Existing Safe guards**	**F**	**S**	**R**	**Recommendations**	**F**	**S**	**R**
			cause									
6	Others	Static Electricity		No HSE hazard								
		Instrument Air failure	Air compressor failure	Pressure rise may possible	1.Air buffer tank is available with PT and alarms. 2.Air compressor running indication on DCS is available. 3.Air failed safe position of vacuum PCV is to be air failed to closed condition.	3	3	9				
		Power Failure	GEB power failure	No HSE hazard	Two numbers of DG is available for power backup.	3	1	3				
		DCS Failure	Battery bank failure	No HSE hazard	Battery bank backup is provided, and PM is done for the same periodically.	3	1	3				
		Agitation	Agitator decouple due to mechanical failure	No HSE hazard	Agitator running indication is available on DCS.	3	1	3				

-------- END OF REPORT --------

HAZOP -DRY HCL						
Sr No	Node	Stream	Recommendations	Department	Status	Page Ref. No.
1	CaCl2 Dosing reactor(012RT -176)	Water charging in CaCl2 Dosing reactor(012RT-176)	Vent line valve should be locked open with tagging.	Mechanical	Completed	1
2	CaCl2 KOD column-102(010CM-085)	CaCl2 transfer in cacl2 KOD column(010CM-085) by cacl2 dosing tank (012RT-176) by gravity	Vent line/vapour line valve should be always locked open condition with tag.	Mechanical	Completed	2
3			Flange guard to be provided in all the flanges.	Mechanical	Completed	3
4			Spill kit provided by near by area to contain spillage	safety	Completed	4
5			TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	5
6	Distillation Column(010C M-084)	Heating , maintaining and CaCl2 circulation in distillation column(010CM -084)	TCV bypass valve should be locked closed condition with tagging.	Mechanical	Completed	6
7		Continuous feeding from HCl receiver(011TK-318) to distillation column(010CM-084) through feeding pump (010TP-321)	Flange guard to be provide on the flanges.	Mechanical	Completed	7
8	Scrubber System(010T K-347)	Reaction in scrubber tank (010TK-347)	Pump discharge valve should be critical locked open condition and tag to be provide on that.	Mechanical	Completed	8
9			Vent line manual vlave to be in critical locked open condition with LO Tag	Mechanical	Completed	9



hcl- 1

3237



HCL-3

3238



HCL- 2

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(2)





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SURAT

HCL- 4 3242

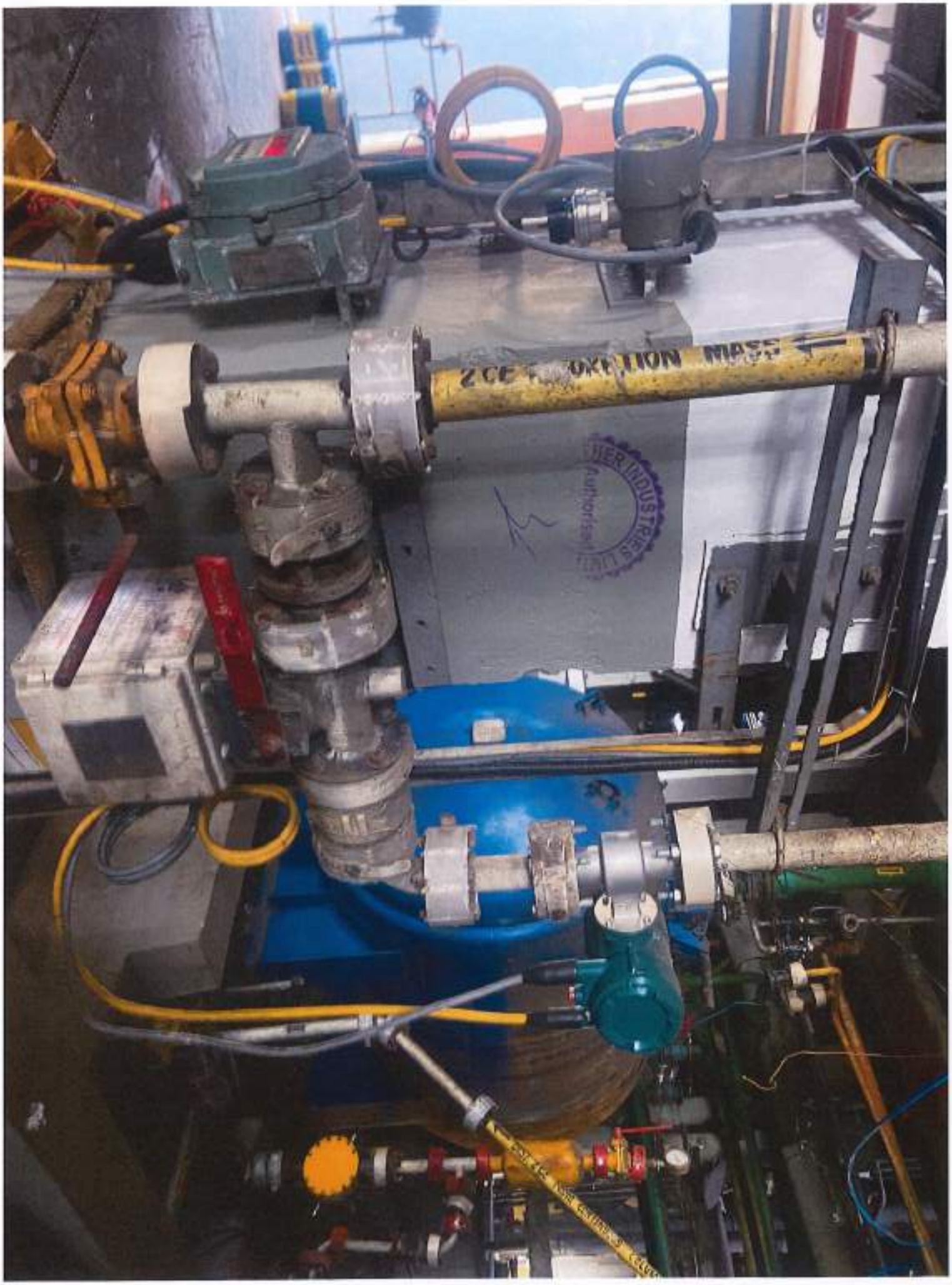
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HCL-5 3243 (6)



Jcl – 63244




POWER BONE
BRICK
BONE



KIRLOSKER INDUSTRIES LIMITED
Authorised
* SURAT *

STAMP OF APPROVAL

1/3



SITE PLAN
SCALE : 1 CM =5.0 M.



KEY PLAN
SCALE : N.T.S.

DRAWING SCHEDULES

SR. NO.	PLANT / STRUCTURE NAME	DRG. SHEET NO.
1	INTERMEDIATE PLANT-1 & 2	APPROVED
2	UTILITY BUILDING	APPROVED
3	WARE HOUSE	APPROVED
4	U/G WATER TANK BLDG.	APPROVED
5	SECURITY CABIN	APPROVED
6	E.T.P.	APPROVED
7	TANK FARM AREA SHED	APPROVED
8	PET. CLASS A+ B U/G TANK AREA	APPROVED
9	E.O. STORAGE TANK SHED	APPROVED
10	LB. GAS STORAGE TANK SHED	APPROVED
11	UTILITY BUILDING-2 CHC, CANTEEN	APPROVED
[illegible]	[illegible]	[illegible]
12	INTERMEDIATE PLANT- 3	APPROVED
13	E.T.P. TANK FARM	APPROVED

NOTE :-
LAST PLAN APPROVED BY DIRECTOR, INDUSTRIAL SAFETY AND HEALTH, GUJARAT STATE, LETTER NO. 7822, DATED : 18 . 11 . 2019

COLOUR CODE
PLOT BOUNDARY SHOWN ——— BLACK
EXTENSION TO BE APPROVED SHOWN ——— RED
FIRE HYDRANT LINE & SPRINKLER LINE SHOWN ——— BROWN

EXTENSION PLAN OF
AETHER INDUSTRIES LIMITED.
PLOT NO. 8203, BESIDE SHAKTI DISTILLARY,
NR. RAJKAMAL CHOKDI, ROAD NO.8,
GIDC SACHIN, DIST.: SURAT-394 230.

SITE PLAN, KEY PLAN

SIGNATURE
For Aether Industries Limited

DRAWN BY
ASHVIN P. PARMAR
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ADAJAN, SURAT.
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EMAIL:- ashvinmp@gmail.com

DATE: 24 / 06 / 2021 SIZE: 24X18

PUNIT A. DEGDAWALA
B.E. CIVIL
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SMC - TDO/ST. DR/379

TRUE COPY ADVOCATE

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Scanned with CamScanner

STAMP OF APPROVAL

1/3



SITE PLAN
SCALE - 1 CM =5.0 M.



KEY PLAN
SCALE - N.T.S.

DRAWING SCHEDULES

SR. NO.	PLANT / STRUCTURE NAME	DRG. SHEET NO.
1	INTERMEDIATE PLANT-1 & 2	APPROVED
2	UTILITY BUILDING	APPROVED
3	WARE HOUSE	APPROVED
4	U/G WATER TANK BLDG.	APPROVED
5	SECURITY CABIN	APPROVED
6	E.T.P.	APPROVED
7	TANK FARM AREA SHED	APPROVED
8	PET. CLASS A+ B U/G TANK AREA	APPROVED
9	C.O. STORAGE TANK SHED	APPROVED
10	LB. GAS STORAGE TANK SHED	APPROVED
11	UTILITY BUILDING-2 CHC, CANTEEN	APPROVED
12	INTERMEDIATE PLANT- 3	APPROVED
13	E.T.P. TANK FARM	APPROVED

NOTE :-
LAST PLAN APPROVED BY DIRECTOR, INDUSTRIAL SAFETY AND HEALTH, GUJARAT STATE, LETTER NO. 7822, DATED : 18 . 11 . 2019

COLOUR CODE
PLOT BOUNDARY SHOWN ——— BLACK
EXTENSION TO BE APPROVED SHOWN ——— RED
FIRE HYDRANT LINE & SPRINKLER LINE SHOWN ——— BROWN

EXTENSION PLAN OF
AETHER INDUSTRIES LIMITED.
PLOT NO. 8203, BESIDE SHAKTI DISTILLARY,
NR. RAJKAMAL CHOKDI, ROAD NO.8,
GIDC SACHIN, DIST.: SURAT-394 230.

SITE PLAN, KEY PLAN

SIGNATURE
For Aether Industries Limited

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DATE: 24 / 06 / 2021 SIZE: 24X36

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SMC - TDO/ST. DR/379

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aether
elementally innovative

ANNEXURE-R-2-Colly

Turnover

Sr. NO	F.Y.	Turnover (INR)
1	2021-2022	590,04,71,950
2	2022-2023	651,07,35,513
3	2023-2024	595,66,92,087

For, Aether Ind Ltd.

AETHER INDUSTRIES LIMITED Authorised SURAT

Authorized Signature.

TRUE COPY ADVOCATE

ANNEXURE-R-3-Colly

સંયુક્ત નિયામક, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્યની કચેરી, સુરત રીજીયન, સુરત
"બી બ્લોક", ૬ઠ્ઠો માળ, જીલ્લા સેવા સદન-૨, અઠવાલાઇન્સ, સુરત.
ફોન નં.૦૨૬૧-૨૬૪૩૪૦૨, ફેકસ નં.૦૨૬૧-૨૬૪૩૪૦૧

Azadi Ka Amrit Mahotsav

કમાંક/સં.નિ/ઔ.સ.સ્વ./સુ.રીજી/૨૭૮૪ /૨૦૨૪
તા. / /૨૦૨૪

08 APR 2024

પ્રતિ,
કબ્જેદારશ્રી
એથર ઇન્ડસ્ટ્રિઝ લી
પ્લોટ નં.૮૨૦૩, રોડ નં. ૮૨.
જી.આઇ.ડી.સી સચીન, તા.ચોર્યાસી, જી. સુરત.

વિષય :- કલમ-૪૦(૨) હેઠળ અંશત હુકમ ઉઠાવવા બાબત.

મહાશયશ્રી,

ઉપરોકત વિષય અન્વયે અત્રેની કચેરીથી તા.૨૯/૧૧/૨૦૨૩ ના રોજ કારખાનામાં આગ-ધડાકાનો બનાવ બનેલ હતો. જેના કારણે કારખાનામાં આવેલ ટેન્ક ફાર્મના શેડના સ્ટ્રકચરને તથા ટેન્ક ફાર્મની બાજુમાં રહેલ પ્લાન્ટ નં.૨ માં નુકશાન થયેલ હતું. જેના અનુસંધાનમ કારખાનાના કબ્જેદારને નીચે સહી કરનાર દ્વારા તા.૨૯/૧૧/૨૦૨૩ ના રોજ મુલાકાત લઈ કારમાના ધારા-૧૯૪૮ ની કલમ-૪૦(૨) હેઠળ સમગ્ર કારખાનામાં ઉત્પાદન પ્રક્રિયા ન કરવા તા.૨૯/૧૧/૨૦૨૩ પત્ર કમાંક/સં.નિ/ઓ.સ.સ્વા./સુ.રીજી/૭૦૫૧/૨૦૨૩ થી હુકમ કરેલ હતો. જે બાબતે નિયામકશ્રી, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય, ગુજરાત રાજ્ય અમદાવાદના અત્રેની કચેરીએથી તા.૨૨/૧૨/૨૦૨૩ ના રોજ પત્ર કમાંક ડીઆઇએસએચ/જી-અકસ્માત/ ૪૦(૨) ફા.૧૨૭/૨૦૨૩/૭૨૩ થી કારખાનામા આવેલ પ્લાંટ નં.૪,૫ તથા ૬ કે જે બિલ્ડીંગ નં.૩ માં આવેલ છે તથા તેને સંલગ્ન યુટીલીટી બિલ્ડીંગ, એડમીન બિલ્ડીંગ, વેરહાઉસ, DCS તથા MCC પેનલ બિલ્ડીંગ, ETP, ETP ટેન્ક ફાર્મ, EO સ્ટોરેજ ટેન્ક ફાર્મ, IB સ્ટોરેજ ટેન્ક ફાર્મ તથા તે સાથે રજુ કરેલ સાઇટ લે-આઉટમાં દર્શાવેલ તમામ ગ્રીન કલરવાળો વિસ્તાર પુરતો કારખાનાધારાની કલમ-૪૦(૨) હેઠળ આપવામા આવેલ હુકમ અંશતઃ ઉઠાવવા પરવાનગી આપવામાં આવેલ હતી. જે અન્વયે અત્રેની કચેરીએથી તા.૨૨/૧૨/૨૦૨૩ ના રોજ પત્ર કમાંક/સં.નિ/ઔ.સ.સ્વ./સુ.રીજી/ ૭૪૬૮/૨૦૨૩ થી ઉપરોકત મુજબના વિસ્તારમાં કારખાનાધારાની કલમ-૪૦(૨) હેઠળ આપવામા આવેલ હુકમ અંશતઃ ઉઠાવવામાં આવેલ હતો.

વધુમાં કારખાનાના કબ્જેદારશ્રી દ્વારા તા.૦૩/૦૪/૨૦૨૪ ના રોજ આવક નં.૪૫૯૫ થી હુકમમાં દર્શાવેલ સલામતીના પગલા અંગે પાલન કર્યા અંગેનો પુર્તતા અહેવાલ કારખાનાના નકશા નં.૧૯૮૨/૩-૮-૨૦૨૧ માં વાદળી કલર દ્વારા દર્શાવેલ પ્લાંટ નં.૩ અને અંડરગ્રાઉંડ સ્ટોરેજ ટેન્ક એરીયા પુરતો રજુ કરેલ હતો. જે બાબતે નિયામકશ્રી, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય, ગુજરાત રાજ્ય અમદાવાદના અત્રેની કચેરીએથી તા.૦૬/૦૪/૨૦૨૪ ના રોજ પત્ર કમાંક ડીઆઇએસએચ/ જી-અકસ્માત/૪૦(૨) ફા.૧૨૭/૨૦૨૩/૧૪૦ થી કારખાનાના નકશા નં.૧૯૮૨/૩-૮-૨૦૨૧ માં વાદળી કલર દ્વારા દર્શાવેલ પ્લાંટ નં.૩ અને અંડરગ્રાઉંડ સ્ટોરેજ ટેન્ક એરીયા ધરાવતા વિસ્તાર માટે કારખાના ધારા - ૧૯૪૮ની કલમ-૪૦(૨) હેઠળનો મનાઇ હુકમ અંશત ઉઠાવવા પરવાનગી મળેલ છે. જેથી સદરહુ કારખાનાના નકશા

નં.૧૯૮૨/૩-૮-૨૦૨૧ માં વાદળી કલર દ્વારા દર્શાવેલ પ્લાંટ નં.૩ અને અંડરગ્રાઉંડ સ્ટોરેજ ટેન્ક એરીયા ધરાવતા વિસ્તાર પુરતી ઉત્પાદન પ્રક્રિયા શરૂ કરવા કારખાના ધારા ૧૯૪૮ની કલમ-૪૦(૨) હેઠળ આપવામાં આવેલ મનાઈ હુકમ ઉઠાવવા અત્રેની કચેરીએથી તા.૦૮/૦૪/૨૦૨૪ ના રોજ અંશત ઉઠાવવામાં આવે છે.

વધુમાં સદરહુ કારખાનામાં ઉપરોક્ત સિવાયના અન્ય ભાગોમાં આપેલ સુચનોનું પાલન થયેથી ફરીથી કારખાના ધારા - ૧૯૪૮ની કલમ-૪૦(૨) હેઠળનો મનાઈ હુકમ ઉઠાવવા મંજુરી મેળવવાની રહેશે.

(બી.એ.ચૌહાણ)
નાયબ નિયામક
ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય
સુરત

Director Industrial Safety and Health
Labour, Skill Development & Employment Department
Government of Gujarat
B-Block, 6th Floor, District Service Sadan 2, Athwalines Surat
Ph-No-0261-2153502, Fax No-0261-2653501
No./Sh.Ni/Aau.sh.sva./Su.Reji/2484/2024

Date : 08 APRIL 2024

To,
Occupier,
Aether Industries Ltd.
Plot No.8203, Road No. 82.
GIDC Sachin, dt. Choryasi, G,
Surat.

Subject :- Regarding partial order under Section-40(2).

Sir,

On 29/11/2023, a fire-explosion incident took place in the factory from the office here. Due to which the shed structure of the tank farm in the factory and adjacent to the tank farm in plant no. Pursuant to which the occupier of the factory was visited by the undersigned on 29/11/2023 under Section-40(2) of the Works Act-1948 not to carry out the production process in the entire factory dated 29/11/2023 Letter No./No. Ordered from /O.S.Swa./Soo.Reg/7051/2023. In this regard, from the office of the Director, Industrial Safety and Health, Gujarat State, Ahmedabad dated 22/12/2023 letter No. DISH/G-Accident/ 40(2) Fa.127/2023/723 to plant No.4 in the factory, 5 and 6 situated in Building No.3 and its adjoining Utility Building, Admin Building, Warehouse, DCS and MCC Panel Building, ETP, ETP Tank Farm, EO Storage Tank Farm, IB Storage Tank Farm and the proposed site The order passed under Section-40(2) of the Factories Act was allowed to be partially lifted to cover all the green colored area shown in the layout. Pursuant to which the order issued under Section-40(2) of the Factories Act in the above mentioned area from this office dated 22/12/2023 vide letter no. : was raised.

Further, the completion report by the occupier of the factory regarding the compliance of the safety measures mentioned in the order dated 03/04/2024 from revenue no.4595, plant no.3 and underground shown in blue color in the factory map no.1982/3-8-2021 The storage tank area was presented as sufficient. In this regard from the office of the Director, Industrial Safety and Health, Gujarat State, Ahmedabad dated 06/04/2024 letter No. DISH/ G-Accident/40(2) Fa.127/2023/140 to Factory Map No.1982/3 - In 8-2021, partial lifting of the injunction under Section-40(2) of the Factories Act-1948 has been granted for the area containing Plant No.3 and Underground Storage Tank Area shown in blue colour. So factory maps

No. 1982/3-8-2021 to lift the injunction granted under Section-40(2) of the Factories Act, 1948 to start the manufacturing process in the plant No. 3 and the area containing the underground storage tank area indicated by blue color from this office Partly lifted dated on 08/04/2024

In addition, due to the compliance of the instructions given in the other parts of the factory apart from the above, permission has to be obtained to lift the injunction under Section-40(2) of the Factories Act - 1948



(B.A Chauhan)
Deputy Director Industrial
Safety and Health,
Surat

This is a English translated copy of Original letter issued by Director Industrial Safety, Surat letter No./Sh.Ni/Aau.sh.sva./Su.Reji/2484/2024, dated 08-04-2024

સંયુક્ત નિયામક, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્યની કચેરી, સુરત રીજીયન, સુરત
"બી બ્લોક", ૬ઠ્ઠો માળ, જીલ્લા સેવા સદન-૨, અઠવાલાઇન્સ, સુરત.
ફોન નં.૦૨૬૧-૨૬૪૩૪૦૨, ફેકસ નં.૦૨૬૧-૨૬૪૩૪૦૧

Azadi Ka Amrit Mahotsav

ક્રમાંક/સ.નિ/ઔ.સ.સ્વ./સુ.રીજી/૩૧૪૬/૨૦૨૪
તા. / /૨૦૨૪

13 MAY 2024

પ્રતિ,
કબ્જેદારશ્રી
એસ્ટર ઇન્ડસ્ટ્રિઝ લી
પ્લોટ નં.૮૨૦૩, રોડ નં. ૮૨.
જી.આઇ.ડી.સી સચીન, તા.ચોર્યાસી, જી. સુરત.

વિષય :- કલમ-૪૦(૨) હેઠળ અંશત: હુકમ ઉઠાવવા બાબત.

મહાશયશ્રી,

ઉપરોકત વિષય અન્વયે અત્રેની કચેરીશ્રી તા.૨૯/૧૧/૨૦૨૩ ના રોજ કારખાનામાં આગ-ધડાકાનો બનાવ બનેલ હતો. જેના કારણે કારખાનામા આવેલ ટેન્ક ફાર્મના શેડના સ્ટ્રકચરને તથા ટેન્ક ફાર્મની બાજુમા રહેલ પ્લાન્ટ નં.૨ માં નુકશાન થયેલ હતું. જેના અનુસંધાનમ કારખાનાના કબ્જેદારને નીચે સહી કરનાર દ્વારા તા.૨૯/૧૧/૨૦૨૩ ના રોજ મુલાકાત લઈ કારમાના ધારા ૧૯૪૮ ની કલમ-૪૦(૨) હેઠળ સમગ્ર કારખાનામાં ઉત્પાદન પ્રકિયા ન કરવા તા.૨૯/૧૧/૨૦૨૩ પત્ર ક્રમાક/સ.નિ/ઓ.સ.સ્વા./સુ.રીજી/૭૦૫૧/૨૦૨૩ થી હુકમ કરેલ હતો. જે બાબતે નિયામકશ્રી, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય, ગુજરાત રાજ્ય અમદાવાદના અત્રેની કચેરીએથી તા.૨૨/૧૨/૨૦૨૩ ના રોજ પત્ર ક્રમાક ડીઆઇએસએચ/જી-અકસ્માત/ ૪૦(૨) ફા.૧૨૭/૨૦૨૩/૭૨૩ થી કારખાનામા આવેલ પ્લાટ નં.૪,૫ તથા ૫ કે જે બિલ્ડીગ નં.૩ મા આવેલ છે તથા તેને સંલગ્ન યુટીલીટી બિલ્ડીગ, એડમીન બિલ્ડીગ, વેરહાઉસ, DCS તથા MCC પેનલ બિલ્ડીગ, ETP, ETP ટેન્ક ફાર્મ, EO સ્ટોરેજ ટેન્ક ફાર્મ, IB સ્ટોરેજ ટેન્ક ફાર્મ તથા તે સાથે રજુ કરેલ સાઇટ લે-આઉટમાં દર્શાવેલ તમામ ગ્રીન કલરવાળો વિસ્તાર પુરતો કારખાનાધારાની કલમ-૪૦(૨) હેઠળ આપવામા આવેલ હુકમ અંશત: ઉઠાવવા પરવાનગી આપવામા આવેલ હતી. જે અન્વયે અત્રેની કચેરીએથી તા.૨૨/૧૨/૨૦૨૩ ના રોજ પત્ર ક્રમાક/સ.નિ/ઓ.સ.સ્વ./સુ.રીજી/૭૪૬૮/૨૦૨૩ થી ઉપરોકત મુજબના વિસ્તારમા કારખાનાધારાની કલમ-૪૦(૨) હેઠળ આપવામા આવેલ હુકમ અંશત: ઉઠાવવામાં આવેલ હતો. ત્યારબાદ નિયામકશ્રી, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય, ગુજરાત રાજ્ય અમદાવાદના અત્રેની કચેરીએથી તા.૦૬/૦૪/૨૦૨૪ ના રોજ પત્ર ક્રમાક ડીઆઇએસએચ/ જી-અકસ્માત/૪૦(૨) ફા.૧૨૭/૨૦૨૩/૧૪૦ થી કારખાનાના નકશા નં.૧૯૮૨/૩-૮-૨૦૨૧ માં વાદળી કલર દ્વારા દર્શાવેલ પ્લાટ નં.૩ અને અંડરગ્રાઉંડ સ્ટોરેજ ટેન્ક એરીયા ધરાવતા વિસ્તાર માટે કારખાના ધારા - ૧૯૪૮ની કલમ-૪૦(૨) હેઠળનો મનાઇ હુકમ અંશત: ઉઠાવવા પરવાનગી મળેલ છે. જે અન્વયે અત્રેની કચેરીએથી તા.૦૮/૦૪/૨૦૨૪ ના રોજ પત્ર ક્રમાક/ સ.નિ/ ઓ.સ.સ્વ./સુ.રીજી/ ૨૪૮૪/૨૦૨૪ થી ઉપરોકત મુજબના વિસ્તારમાં કારખાનાધારાની કલમ-૪૦(૨) હેઠળ આપવામા આવેલ હુકમ અંશત: ઉઠાવવામા આવેલ હતો.

વધુમાં કારખાનાના કબ્જેદારશ્રી દ્વારા તા.૦૬/૦૫/૨૦૨૪ ના રોજ આવક નં.૫૪૫૦ થી હુકમમાં દર્શાવેલ સલામતીના પગલા અંગે પાલન કર્યા અંગેનો પુર્તતા અહેવાલ કારખાનાના નકશા નં.૧૯૮૨/૩-૮-૨૦૨૧ માં કેસરી કલર દ્વારા દર્શાવેલ પ્લાટ નં.૧ તથા અબાઉ ગ્રાઉંડ ટેન્ક એરીયા પુરતો રજુ કરેલ હતો. જે બાબતે નિયામકશ્રી, ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય, ગુજરાત રાજ્ય અમદાવાદની કચેરીના તા.૦૯/૦૫/૨૦૨૪ ના રોજ પત્ર ક્રમાંક ડીઆઇએસએચ/ જી-અકસ્માત/૪૦(૨) ફા.૧૨૭/૨૦૨૩/૨૨૪ થી કારખાનાના નકશા નં.૧૯૮૨/૩-૮-૨૦૨૧ માં કેસરી કલર દ્વારા દર્શાવેલ પ્લાટ નં.૧ તથા અબાઉ ગ્રાઉંડ ટેન્ક એરીયા ધરાવતા વિસ્તાર માટે કારખાના ધારા - ૧૯૪૮ની કલમ-૪૦(૨) હેઠળનો મનાઇ હુકમ અંશત: ઉઠાવવા પરવાનગી મળેલ છે. જેથી સદરહુ કારખાનાના નકશા નં.૧૯૮૨/૩-૮-૨૦૨૧ મા કેસરી કલર દ્વારા દર્શાવેલ પ્લાટ નં.૧ તથા અબાઉ ગ્રાઉંડ ટેન્ક એરીયા ધરાવતા વિસ્તાર પુરતી ઉત્પાદન પ્રક્રિયા શરૂ કરવા કારખાના ધારા ૧૯૪૮ની કલમ-૪૦(૨) હેઠળ આપવામાં આવેલ મનાઈ હુકમ અત્રેની કચેરીએથી તા.૧૩/૦૫/૨૦૨૪ ના રોજ અંશત: ઉઠાવવામાં આવે છે.

વધુમાં સદરહુ કારખાનામાં ઉપરોક્ત સિવાયના અન્ય ભાગોમાં આપેલ સુચનોનું પાલન થયેથી ફરીથી કારખાના ધારા - ૧૯૪૮ની કલમ-૪૦(૨) હેઠળનો મનાઈ હુકમ ઉઠાવવા મંજુરી મેળવવાની રહેશે.

BAChauhan

(બી.એ.ચૌહાણ)
નાયબ નિયામક
ઔદ્યોગિક સલામતી અને સ્વાસ્થ્ય
સુરત

Director Industrial Safety and Health
Labour, Skill Development & Employment Department
Government of Gujarat
B-Block, 6th Floor, District Service Sadan 2, Athwalines Surat
Ph-No-0261-2153502, Fax No-0261-2653501

No./Sh.Ni/Aau.sh.sva./Su.Reji/3119/2024

Date : 13 MAY 2024

To,
Occupier,
Aether Industries Ltd.
Plot No.8203, Road No. 82.
GIDC Sachin, dt. Choryasi, G,
Surat.

Subject :- Matter of partial lifting of order under Section-40(2).

Sir,

On 29/11/2023, a fire-explosion incident took place in the factory from the office here. Due to which the shed structure of the tank farm in the factory and adjacent to the tank farm in plant no. Pursuant to which the occupier of the factory was visited by the undersigned on 29/11/2023 under Section-40(2) of the Works Act-1948 not to carry out the production process in the entire factory dated 29/11/2023 Letter No./S. Ordered from /O.S.Swa./Soo Reg/7051/2023. In this regard, from the office of the Director, Industrial Safety and Health, Gujarat State, Ahmedabad dated 22/12/2023 letter No. DISH/G-Accident/ 40(2) Fa.127/2023/723 to Plant No.4 in the factory, 5 and 6 situated in Building No.3 and its adjoining Utility Building, Admin Building, Warehouse, DCS and MCC Panel Building, ETP, ETP Tank Farm, EO Storage Tank Farm, IB Storage Tank Farm and the proposed site The order passed under Section-40(2) of the Factories Act was allowed to be partially lifted to cover all the green colored area shown in the layout. Pursuant to which the order issued under Section-40(2) of the Factories Act in the above mentioned area from this office dated 22/12/2023 vide letter no. had come Thereafter, from the office of the Director, Industrial Safety and Health, Gujarat State Ahmedabad dated 06/04/2024 letter No. DISH/G-Accident/40(2) Fa.127/2023/140 to Factory Map No.1982/3- 8-2021 permission to partially lift the injunction under Section-40(2) of the Factories Act, 1948 for the area containing Plant No.3 and Underground Storage Tank Area indicated by blue colour. Pursuant to which the order issued under Section-40(2) of the Factories Act in the above mentioned area from this office dated 08/04/2024 vide letter no. : was raised.

In addition, the completion report by the occupier of the factory regarding the compliance of the safety measures mentioned in the order dated 06/05/2024 from

revenue no.5450 in the factory map no.1982/3-8-2021 plant no.1 shown in saffron color and above The ground tank area was presented as sufficient. In this regard, the Director, Industrial Safety and Health, Gujarat State Ahmedabad office dated 09/05/2024 letter No. DISH/G-Aksmat/40(2) Fa.127/2023/224 to Factory Map No.1982/3- 8-2021 permission to partially lift the injunction under Section-40(2) of the Factories Act - 1948 for the area containing Plant No.1 and above ground tank area indicated by Kesari Color. Therefore, the injunction issued under Section-40(2) of the Factories Act, 1948 to start the production process for the area of Plant No.1 and above ground tank area indicated by saffron color in Factory Map No.1982/3-8-2021 from this office. Partially lifted on 13/05/2024

In addition, due to the compliance of the instructions given in the other parts of the factory apart from the above, permission has to be obtained to lift the injunction under Section-40(2) of the Factories Act - 1948..



(B.A Chauhan)
Deputy Director Industrial
Safety and Health,
Surat

This is a English translated copy of Original letter issued by Director Industrial Safety, Surat letter
No./Sh.Ni/Aau.sh.sva./Su.Reji/3119/2024 , dated 13-05-2024

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Date - 23/07/2023

To,
Deputy Director Industrial Safety and Health,
District Service Sadan-2,
Athwalines, Surat,

subject: Regarding sending the report on completion of outstanding matters mentioned in the referred circular dated 18/03/2024.

Ref.: Office of the Joint Director of Industrial Safety and Health, Surat Circular No./No. o.s.s/su.rg/2097/2024

Dear sir,

With reference to the above subject and reference, Mr. Brijesh Chauhan, Deputy Director Industrial Safety and Health, Surat, visited our company, the report of the matters suggested during the visit is enclosed herewith.

Authorized

Aether Industries Ltd.

Encl. Annexure - 1 SOP of Hazardous Chemical Pipelines Inspection with Checklist
Annexure- 2 Revise SOP of PM of Flat Bottom Storage Tank
Annexure - 3 Photograph of earlier & Current Recommendation of piping integrity

AETHER INDUSTRIES LIMITED Authorised SURAT

સંયુક્ત નિયામક,
ઔદ્યોગિક સલામતી અને સ્વાસ્થ્યની કચેરી
સુરત ડિવિઝન, સુરત
27 MAR 2024

Aether Industries Ltd.
Registered Office / Factory: Plot No. 8203, Beside Shakti Distillary,
Nr. Rajkamal Chokdi, Road No. 8, Sachin GIDC, Sachin, Surat - 394230 Gujarat - India
Phone: +91-261-6603000 **Email:** info@aether.co.in **Web:** www.aether.co.in

English Translate copy of Letter.

o/c

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તા.: ૨૭/૦૩/૨૦૨૪

પ્રતિ,
નાયબ નિયામક
ઔધોગિક સલામતી અને સ્વાસ્થ્ય,
જીલ્લા સેવા સદન-૨,
અઠવાલાઇન્સ,
સુરત,

વિષય: તા. ૧૮/૦૩/૨૦૨૪ ના સંદર્ભદર્શિત પરિપત્રમાં ઉલ્લેખિત બાકી રહેલ બાબતોની પૂર્તતા અહેવાલ મોકલવા બાબત.

સંદર્ભ.: સંયુક્ત નિયામક ઔધોગિક સલામતી અને સ્વાસ્થ્ય, ની કચેરી, સુરત નો પરિપત્ર ક્રમાંક/સં.નિ /ઔ.સં.સ્વ./સુ.રીજી/૨૦૯૭/૨૦૨૪

શ્રીમાન,

ઉપરોક્ત વિષય અને સંદર્ભ પરત્વે જણાવવાનું કે, આપ શ્રી બી.એ.ચૌહાણ, નાયબ નિયામક ઔધોગિક સલામતી અને સ્વાસ્થ્ય, સુરત, અમારી કંપની માં મુલાકાત લીધી હતી, મુલાકાત દરમિયાન સૂચવેલ બાબતો નો અહેવાલ આ સાથે બિડાણ કરેલ છે.

ઔથોરાઇઝ્ડ

એથર ઇન્ડસ્ટ્રીસ લિમિટેડ

Encl. Annexure - 1 SOP of Hazardous Chemical Pipelines Inspection with Checklist
Annexure- 2 Revise SOP of PM of Flat Bottom Storage Tank
Annexure - 3 Photograph of earlier & Current Recommendation of piping integrity

ઇનવર્ડ/રવાનગી
કલાર્ક
સંયુક્ત નિયામક,
ઔધોગિક સલામતી અને સ્વાસ્થ્યની કચેરી
સુરત રીજીયન, સુરત
27 MAR 2024

AETHER INDUSTRIES LIMITED * SURAT * Authorised

Aether Industries Ltd.
Registered Office / Factory: Plot No. 8203, Beside Shakti Distillary,
Nr. Rajkamal Chokdi, Road No. 8, Sachin GIDC, Sachin, Surat - 394230 Gujarat - India
Phone: +91-261-6603000 **Email:** info@aether.co.in **Web:** www.aether.co.in

MASTER COPY

STANDARD OPERATING PROCEDURE

AETHER INDUSTRIES LIMITED		
SOP No. : SOP-MD-013	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPT. : MAINTENANCE
TITLE: PROCEDURE FOR HAZARDOUS CHEMICAL PIPELINES INSPECTION		PAGE NO.:1 of 4

1.0 OBJECTIVE :

1.1 To lay down a written procedure for inspection of hazardous pipelines.

2.0 SCOPE :

2.1. This procedure shall be applicable to any Hazardous chemical pipeline at Aether Industries Limited.

3.0 RESPONSIBILITY :

3.1. It is responsibility of the maintenance department to follow the SOP of Hazardous pipelines inspection as per the procedure.

3.2. It is responsibility of user department to clean, drain, flush and keep the pipelines ready for inspection as per the procedure.

4.0 PROCEDURE :

4.1. Schedule for inspection of hazardous pipelines should be prepared to cover all the pipes of the plant once in a week.

4.2. Check list should be filled as per Annexure-I.

4.3. Pipeline will be checked for Valve condition, Valve handle, leakage and operability of valve.

4.4. All the vent and drain points will be checked and cap/blind.

4.5. Flange joints shall be checked for oozing leakage, condition of nut and bolts, and tightness.

4.6. Pipeline shall be checked for corrosion and paint condition.

4.7. Pipeline supports if provided shall be checked for its condition.

	PREPARED BY	REVIEWED BY	APPROVED BY
NAME & DEPARTMENT	MAULIK GHOIYA MAINTENANCE	PARAG DETROJA MAINTENANCE	NIKHIL ELAICHAWALA QA/QC
SIGNATURE			
DATE			

STANDARD OPERATING PROCEDURE

AETHER INDUSTRIES LIMITED		aether
SOP No. : SOP-MD-013	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPT. : MAINTENANCE
TITLE: PROCEDURE FOR HAZARDOUS CHEMICAL PIPELINES INSPECTION		PAGE NO.:2 of 4

4.8. Pipeline shall be checked for sagging of the line.

4.9. Insulation shall be checked for its intact and damage.

4.10. Identification of pipe should be checked for proper name and its readability.

4.11. Direction arrow should be checked for correctness.

4.12. Earthing and bonding connection should be checked for tightness.

4.13. Ensure the field operator is available during the inspection.

4.14. Ensure Mandatory PPE's Must be used during work

4.15. If any deviation is observed, it should be corrected on priority and information should be given to production in charge.

4.16. Permit should be taken for carrying any activity, even for tightening the nut and bolt.

4.17. Take pressure test of pipe end to end while undertaking pressure testing of connected vessel as per the factories act.

5.0 ABBREVIATIONS:

5.1. SOP : Standard Operating Procedure

5.2. MD : Maintenance department

5.3. DP : Dew Point

6.0 REFERENCES:

In-House

	PREPARED BY	REVIEWED BY	APPROVED BY
SIGNATURE			
DATE			

STANDARD OPERATING PROCEDURE

AETHER INDUSTRIES LIMITED		aether
SOP No. : SOP-MD-013	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPT. : MAINTENANCE
TITLE: PROCEDURE FOR HAZARDOUS CHEMICAL PIPELINES INSPECTION		PAGE NO.3 of 4

7.0 ANNEXURES:

Annexure No.	Title	Format Number
ANNEXURE - I	Checklist for Hazardous Pipeline inspection	F-01-03 SOP-MD-013

8.0 SUMMARY OF CHANGES:

Change control No	Reason for revision
N/A	New SOP

	PREPARED BY	REVIEWED BY	APPROVED BY
SIGNATURE			
DATE			

STANDARD OPERATING PROCEDURE

AETHER INDUSTRIES LIMITED		
SOP No. : SOP-MD-013	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPT. : MAINTENANCE
TITLE: PROCEDURE FOR HAZARDOUS CHEMICAL PIPELINES INSPECTION		PAGE NO.:4 of 4

9.0 DISTRIBUTION TO:

S. No.	Department	Distribution required (√) / not required (X)
01	Quality Assurance	√
02	Quality Control	√
03	Production	√
04	Maintenance department	√
05	Warehouse	√
06	HR	√
07	Instrument and control	√
08	Electrical department	√
09	Safety, health & environment	√
10	Any other	√

	PREPARED BY	REVIEWED BY	APPROVED BY
SIGNATURE			
DATE			

Form # F-01 of SOP-QA-001

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CHECKLIST FOR HAZARDOUS PIPELINES INSPECTION

CHECKLIST FOR HAZARDOUS PIPELINES INSPECTION

Date : 16/11/2024
Equipment TAG No : SPA line
Block : INT-04

Sr.No.	Description	observation	Remark
1.	Check Valve condition, Valve handle, leakage and operability of valve.	OK.	
2.	All the vent and drain points will be checked and cap/blind	Checked, OK	
3.	Flange joints shall be checked for oozing leakage, condition of nut and bolts and tightness.	O K.	
4.	Pipeline shall be checked for corrosion and paint condition.	Painting Done	
5.	Pipeline supports if provided shall be checked for its condition	OK	
6.	Pipeline shall be checked for sagging of the line	O K.	
7.	Identification of pipe should be checked for proper name and its readability.	Tagging Done	
8.	Insulation shall be checked for its intact and damage.	OK	
9.	Direction arrow should be checked for correctness.	O K	
10.	Earthing and bonding connection should be checked for tightness.	OK	
11.	Ensure the field operator is available during the inspection	OK	
12.	Ensure Mandatory PPE's Must be used during work	OK	
13.	If any deviation is observed, it should be corrected on priority and information should be given to production in charge.	OK	

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14.	Permit should be taken for carrying any activity, even for tightening the nut and bolt	Yes	
15.	Take pressure test of pipe end to end while undertaking pressure testing of connected vessel as per the factories act.	Yes	

NOTE:-

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CHECKLIST FOR HAZARDOUS PIPELINES INSPECTION

CHECKLIST FOR HAZARDOUS PIPELINES INSPECTION	Date	: 01/03/2024
	Equipment TAG No	: Gas Pipeline
	Block	: UNIT-01

Sr.No.	Description	observation	Remark
1.	Check Valve condition, Valve handle, leakage and operatibility of valve.	OK	
2.	All the vent and drain points will be checked and cap/blind	OK	
3.	Flange joints shal be checked for oozing leakage, condition of nut and bolts.and tightness.	OK	
4.	Pipeline shall be checked for corrosion and paint condition.	Painting Done	
5.	Pipeline supports if provided shall be checked for its condition	Satisfactory Done	
6.	Pipeline shall be checked for sagging of the line	OK	
7.	Identification of pipe should be checked for proper name and its readability	OK	
8.	Insulation shall be checked for its intact and damage.	OK	
9.	Direction arrow should be checked for correctness.	Painting Done	
10.	Earthing and bonding connection should be checked for tightness	OK	
11.	Ensure the field operator is available during the inspection	OK	
12.	Ensure Mandatory PPE's Must be used during work	OK	
13.	If any deviation is observed, it should be corrected on priority and information should be given to production in charge	OK	

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14.	Permit should be taken for carrying any activity, even for tightening the nut and bolt.	etc.	
15.	Take pressure test of pipe end to end while undertaking pressure testing of connected vessel as per the factories act.	etc.	

NOTE:-

STANDARD OPERATING PROCEDURE

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SOP NO. : SOP-MD-012	VERSION NO. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPARTMENT : MAINTENANCE
TITLE : PREVENTIVE MAINTENANCE PROCEDURE FOR FLAT BOTTOM STORAGE TANKS		PAGE NO. 1 of 4

1.0 OBJECTIVE :

1.1 To lay down a standard procedure for prevertive maintenance of al storage tank.

2.0 SCOPE :

2.1 This procedure shall be applicable to all storage tank used at Aether Industries Limited

3.0 RESPONSIBILITY :

3.1 It is responsibility of the maintenance department to prepare the maintenance schedule for all storage tank and perform the preventive maintenance as per the procedure.

3.2 It is responsibility of the maintenance lead to ensure that storage tank preventive maintenance was done as per the approved schedule.

3.3 It is responsibility of user department to clean and keep the storage tank ready for preventive maintenance as per the procedure

4.0 PROCEDURE :

4.1 Frequency: Once in Six Month.

4.2 Ensure storage tank is emptied and free from any type of contamination.

4.3 Check condition of tank's interior and exterior shell plates.

	PREPARED BY	REVIEWED BY	APPROVED BY
NAME & DEPARTMENT	VAULIK GEDIYA MAINTENANCE	PARAG DETROJA MAINTENANCE	NIKHIL ELAICHAWALA QA/QC
SIGNATURE			
DATE			

AETHER INDUSTRIES LIMITED		
SOP No. : SOP-MD-012	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPARTMENT :MAINTENANCE
TITLE : PREVENTIVE MAINTENANCE PROCEDURE FOR FLAT BOTTOM STORAGE TANKS		PAGE NO.:2 of 4

4.4 Check condition of tank's bottom plates.

4.5 Check condition of fixed/floating roof, If found damaged then rectify it.

4.6 Check condition of above ground piping, If found damaged then rectify it.

4.7 Check condition pumps and tank foundations and supports.

4.8 Check containment area free from standing water, Fire Hazards and debris

4.9 Ensure drain valves is in closed position.

4.10 Ensure the tank and piping are intact without any evidence of release.

4.11 Ensure the ancillary equipment intact without any evidence of release.

4.12 Ensure proper functionality of all valves.

4.13 Check all vents clear from any type of obstructions.

4.14 Ensure functionality of monitoring device

4.15 Take Thickness of shell side around tank and mention as per Annexure - ..

4.16 Follow all the procedure as per annexure-I and fill the preventive maintenance check list of storage tank as monticned as per Annexure-I.

5.0 ABBREVIATIONS :

5.1 SOP : Standard operating procedure

5.2 MD : Maintenance department

5.3 DP : Dew Point

	PREPARED BY	REVIEWED BY	APPROVED BY
SIGNATURE			
DATE			

STANDARD OPERATING PROCEDURE

AETHER INDUSTRIES LIMITED		aether environmentally innovative
SOP No. : SOP-MD-012	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPARTMENT :MAINTENANCE
TITLE : PREVENTIVE MAINTENANCE PROCEDURE FOR FI AT BOTTOM STORAGE TANKS		PAGE NO.:3 of 4

6.0 REFERENCES :

6.1 In-House

7.0 ANNEXURE :

Annexure No.	Title	Format Number
Annexure - I	Preventive maintenance of storage tank	F-01-00-SOP-MD 012

8.0 SUMMARY OF CHANGES :

Change control No.	Reason for revision
N/A	New SOP

	PREPARED BY	REVIEWED BY	APPROVED BY
SIGNATURE			
DATE			

Form # F-01-00-SOP-QA-001

STANDARD OPERATING PROCEDURE

AETHER INDUSTRIES LIMITED		
SOP No. : SOP-MD-012	VERSION No. : 00	SUPERSEDES : NEW
EFFECTIVE DATE :	NEXT REVIEW DATE :	DEPARTMENT :MAINTENANCE
TITLE : PREVENTIVE MAINTENANCE PROCEDURE FOR FLAT BOTTOM STORAGE TANKS		PAGE NO.:4 of 4

9.0 DISTRIBUTION TO :

S.No.	Department	Distribution required(√) not required (X)
01	Quality Assurance	√
02	Quality Control	√
03	Production	√
04	Maintenance department	√
05	Warehouse	√
06	HR	√
07	Instrument and control	√
08	Electrical department	√
09	Safety, health & environment	√
10	Any other	√

	PREPARED BY	REVIEWED BY	APPROVED BY
SIGNATURE			
DATE			

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ANNEXURE – 1 to SOP-MD-012

PREVENTIVE MAINTENANCE OF STORAGE TANK

PREVENTIVE MAINTENANCE CHECKLIST FOR STORAGE TANK		Date : Equipment TAG No : Block :	
S.No	Description	Status Yes / No	Comments/ Actions/ Date Corrected
1	Are the tank's interior and exterior shell plates in good condition?		
2	Is the tank's bottom plate in good condition?		
3	Is the fixed/floating roof in good condition?		
4	Is the above ground piping in good condition?		
5	Are the foundations and supports in good condition?		
6	Is the containment area free of standing water?		
7	Are the drain valves in a closed position?		
8	Is the containment area clear of fire hazards and debris?		
9	Are the tank and piping intact, without any evidence of release?		
10	Is the ancillary equipment intact, without any evidence of release?		
11	Are the valves functioning properly?		
12	Are the vents clear of obstructions?		
13	Is the monitoring device functioning properly?		
14	Thickness testing of shell side around tank Avg		
15	Thickness testing of top side around tank Avg.		
16	Thickness testing of bottom side around tank Avg.		
17	All Nut & bolt condition in Tank Top & bottom condition are OK.		
18	All nozzle gasket are OK or gasket replaced ?		

Note:-

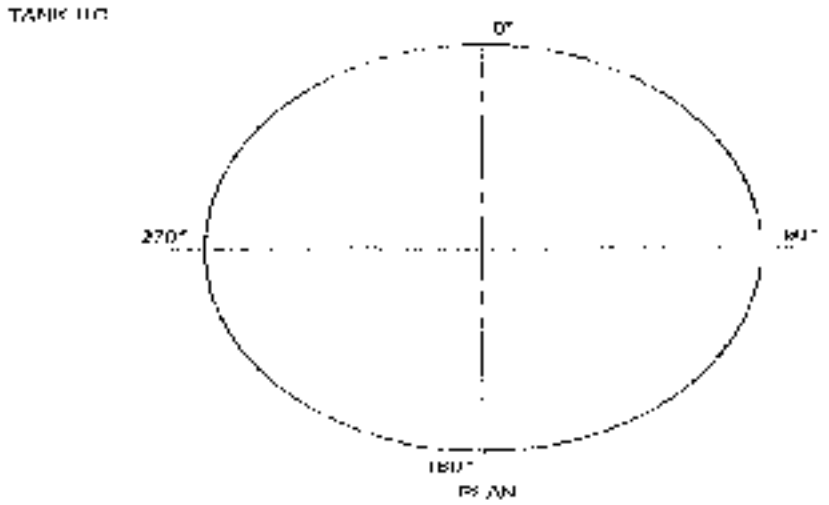
	PREPARED BY	REVIEWED BY	APPROVED BY
NAME & DEPARTMENT	MAULIK GEDIYA MAINTENANCE	PARAG DETROJA MAINTENANCE	NIKHIL ELAICHAWALA QA/QC
SIGNATURE			
DATE	25/01/2024	25/01/2024	25/01/24

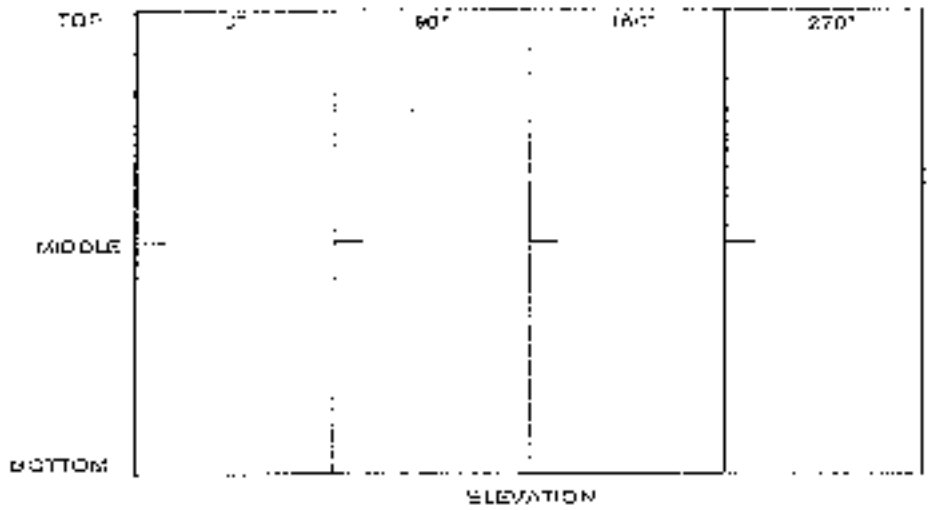
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ANNEXURE – I to SOP-MD-012

PREVENTIVE MAINTENANCE OF STORAGE TANK





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PREVENTIVE MAINTENANCE OF STORAGE TANK

PREVENTIVE MAINTENANCE CHECKLIST FOR STORAGE TANK

Date : 25/01/2024
Equipment TAG No : 04-ST-159
Block : SPM-04

S.No	Description	Status Yes / No	Comments/ Actions/ Date Corrected
1	Are the tank's interior and exterior shell plates in good condition?	Yes	
2	Is the tank's bottom plate in good condition?	Yes	
3	Is the fixed/floating roof in good condition?	Yes	
4	Is the above ground piping in good condition?	Yes	Painting work Done
5	Are the foundations and supports in good condition?	Yes	Painting work Done
6	Is the containment area free of standing water?	Yes	
7	Are the drain valves in a closed position?	Yes	
8	Is the containment area clear of fire hazards and debris?	Yes	
9	Are the tank and piping intact without any evidence of release?	Yes	
10	Is the ancillary equipment intact, without any evidence of release?	Yes	
11	Are the valves functioning properly?	Yes	
12	Are the vents clear of obstructions?	Yes	
13	Is the monitoring device functioning properly?	Yes	
14	Thickness testing of shell side around tank Avg.	Yes	Avg. thickness 6.1 mm
15	Thickness testing of top side around tank Avg.	Yes	Avg. thickness 6.2 mm
16	Thickness testing of bottom side around tank Avg.	Yes	Avg. thickness 6.2 mm
17	All Nut & bolt condition in Tank Top & bottom condition are OK.	Yes, OK	
18	All nozzle gasket are OK or gasket replaced ?	Yes, OK	

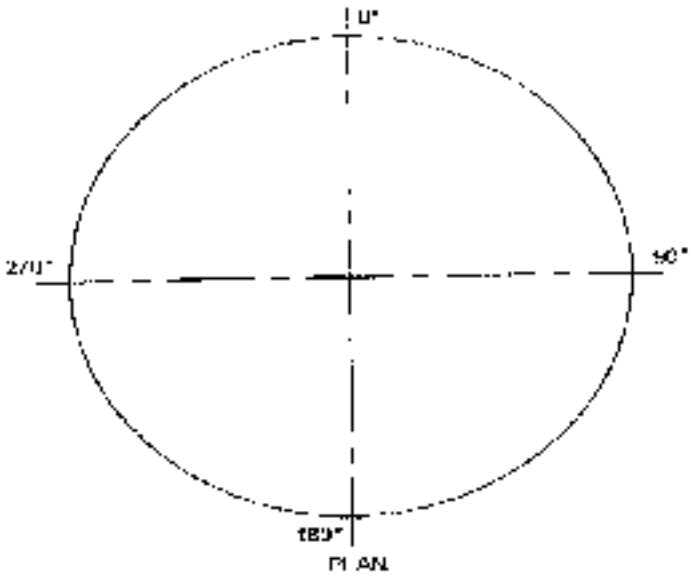
Note:-

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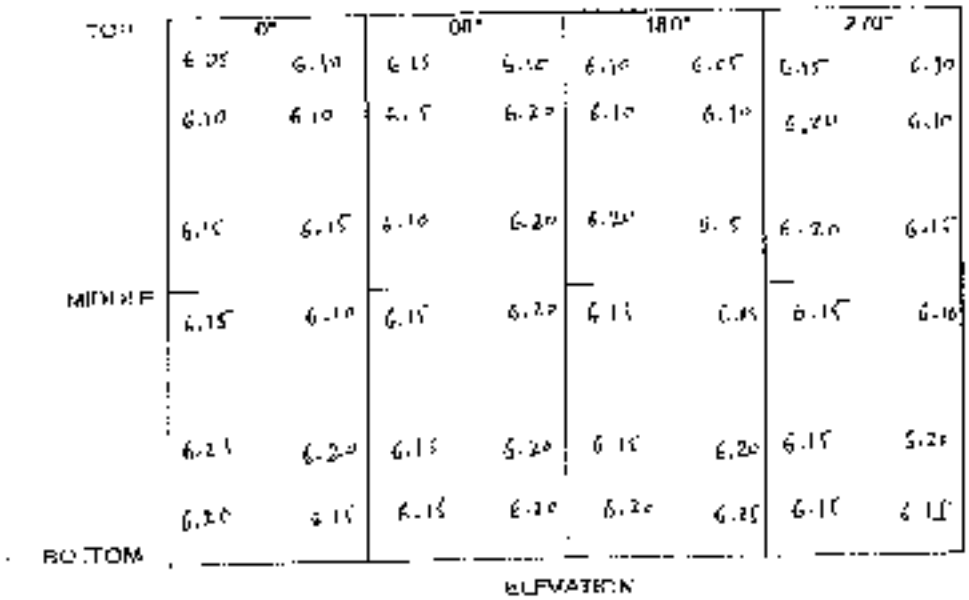
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PREVENTIVE MAINTENANCE OF STORAGE TANK

TANK NO -



PLAN



ELEVATION

Checked by MD

(Sign & date)

25/01/2024

Checked By PD

(Sign & date)

25/01/2024

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PREVENTIVE MAINTENANCE OF STORAGE TANK

PREVENTIVE MAINTENANCE CHECKLIST FOR STORAGE TANK

Date : 28/01/2024
Equipment TAG No : GHO 51-03
Block : SNT-04

S.No	Description	Status Yes / No	Comments/ Actions/ Date Corrected
1	Are the tank's interior and exterior shell plates in good condition?	Yes	
2	Is the tank's bottom plate in good condition?	Yes	
3	Is the fixed/floating roof in good condition?	Yes	
4	Is the above ground piping in good condition?	Yes	piping painting Done
5	Are the foundations and supports in good condition?	Yes	
6	Is the containment area free of standing water?	Yes	
7	Are the drain valves in a closed position?	Yes	
8	Is the containment area clear of fire hazards and debris?	Yes	
9	Are the tank and piping intact, without any evidence of release?	Yes	
10	Is the ancillary equipment intact, without any evidence of release?	Yes	
11	Are the valves functioning properly?	Yes	
12	Are the vents clear of obstructions?	Yes	
13	Is the monitoring device functioning properly?	Yes	
14	Thickness testing of shell side around tank Avg.	Done	Avg. Thickness = 6.1mm
15	Thickness testing of top side around tank Avg.	Done	Avg. Thickness = 6.1mm
16	Thickness testing of bottom side around tank Avg.	Done	Avg. Thickness = 6.2mm
17	All Nut & bolt condition in Tank Top & bottom condition are OK	OK	
18	All nozzle gasket are OK or gasket replaced ?	OK	

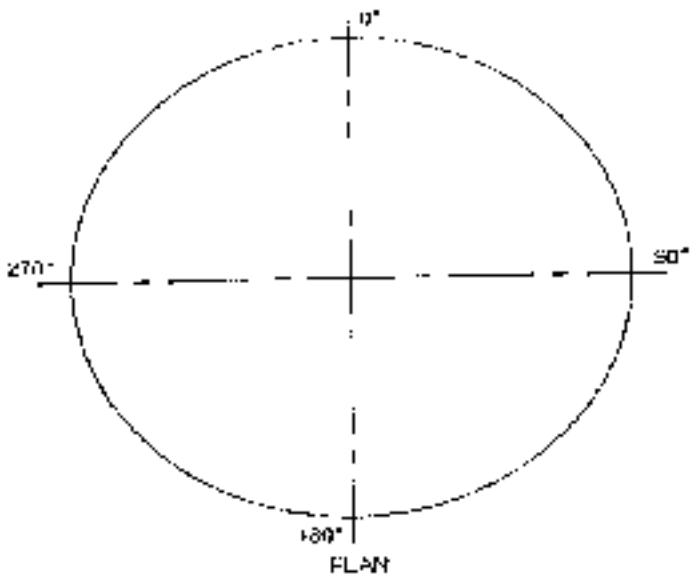
Note:-

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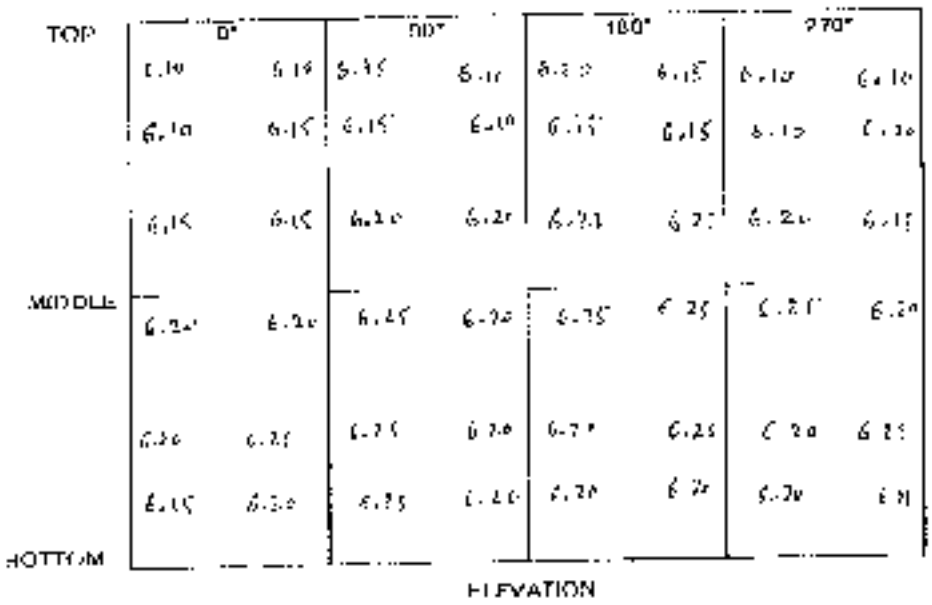
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PREVENTIVE MAINTENANCE OF STORAGE TANK

TANK NO:



PLAN



ELEVATION

Checked by MD

(Sign & date)

Checked By PD

(Sign & date)



EO & IB line- Pipe rack- All structural components are found without painted. And pipe rack found not lock/weld with civil wall at terrace b/w MVR plant to ETP plant. Need to be rectify. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And pipe rack found not lock/weld with civil wall at terrace b/w MVR plant to ETP plant. Need to be rectify. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And pipe rack found not lock/weld. with civil floor terrace b/w ETP plant to store/ware house. Need to be done. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And pipe rack found not lock/weld. with civil floor terrace b/w ETP plant to store/ware house. Need to be done. Rust Gr 3-G

AETHER INDUSTRIES LIMITED Authorised SURAT



EO & IB line- Pipe rack- All structural components are found without painted. And bottom connected members (Angle to Channel) are not complete weld. at terrace area b/w ETP plant to store/ware house. Need to be rectify. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And pipe rack found not lock/weld. with civil floor terrace at ETP plant. Need to be rectify. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And typical. (ETP plant) Rust Gr 3-G



ETP plant: Stair found corroded way to terrace. Need to be corrective action. Rust Gr 2-G

ADHER INDUSTRIES LIMITED Authorised * SURAT *



ETP plant: Stair found corroded and found not lock with civil floor- Way to terrace. Need to be corrective action. Rust Gr 2-G



EO & IB line- Pipe rack- All structural components are found without painted. And bottom connected members (Angle to Channel) are not complete weld. at terrace area b/w ETP to store/ware house. Need to be done. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And bottom connected members (Angle to Channel) are not complete weld. at terrace area b/w ETP to store/ware house. Need to be done. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And typical. (Store house to ware house terrace.) Rust Gr 3-G

AETHER INDUSTRIES LTD. Authorised Signatory SURAT

4 VISUAL INSPECTION

E.O. AND IB PIPING INTEGRITY

❖ **Detail Photographs with Description (EO & IB Line)**



EO & IB Tank Farm Area: All structural components- Paint found peel off. Need to be clean & paint regularly. Rust Gr 3-G



MVR Plant: EO & IB lines are found covered with Acoustic insulated.



EO & IB line- Pipe rack- All structural components are found without painted. And bottom connected members (Angle to Channel) are not complete weld. at terrace area b/w MVR plant to ETP plant. Need to be done. Rust Gr 3-G



EO & IB line- Pipe rack- All structural components are found without painted. And bottom connected members (Angle to Channel) are not complete weld. at terrace area b/w MVR plant to ETP plant. Need to be done. Rust Gr 3-G

AETHER INDUSTRIES Authorised SURAT


Authorised

3284





3286




TRUE COPY
ADVOCATE
Authorised Signatory

ANNEXURE-R-4

GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,
GANDHINAGAR - 382010,
(T) 079-23232152

GPCB

BY RPAD

REVOCATION OF CLOSURE ORDER ISSUED UNDER SECTION 31 A OF THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT-1981. [HEREINAFTER REFERRED TO AS THE "AIR ACT"] AS AMENDED FROM TIME TO TIME.

WHEREAS you are having an Industrial plant namely M/s. Aether Industries Ltd located at Plot No. 8203, GIDC Sachin - 394230 Tal: Chorasi, Dist: Surat

AND WHEREAS the Gujarat Pollution Control Board has granted Consolidated Consent and Authorization (CC & A) under the provisions of the Environmental Acts Rules by its Consent Order No. AWH-118971 for W - 26157 which is valid up to 06-03-2028.

AND WHEREAS closure direction was issued under Section 31-A of the Air (Prevention and Control of Pollution) Act, 1981, as mentioned hereinafter in the vide letter No. GPCB/CCA/SRT/20806/ID-15350/739063 dated: 30.12.2023.

AND WHEREAS, thereinafter, Closure revocation order was issued under Section 31-A of the Air (Prevention and Control of Pollution) Act, 1981 as amended from time to time vide letter No. GPCB/CCA/SRT/20806/ID-15350/780388 dated 05.07.2024

AND WHEREAS, during the inspection of your industrial plant on 29.02.2024 under Section 21 of the Air Act by the authorized officer of the Board, and observed that

1. Unit is found in operation with 35% production capacity in One Building No. 4
2. Generated wastewater due to firefighting is collected & finally wastewater (IDS 6 KL) is discharged into the CETP of GPCL & wastewater (IDS 855 KL) is sent to Common MEE of Detox Enviro Pvt. Ltd., Ankleshwar through online manifest system
3. Generated burnt / partially burnt material (8.340 MT) due to fire incident is sent to M/s. RSPL for suitable treatment. Until this is not disposed of 9.175 MT Burnt partially burnt material at BH-1 - Ankleshwar through online manifest system

Outward No:811646, 18/05/2024

i. As per the submitted compensation details, total 10 Nos of workers are died due to incident dated 29.11.2023 (During rescue 07 dead bodies were found within the affected area & 3 workers were died during the treatment in Hospital & other 21 nos of workers are injured and admitted to hospital. As on today, out of them 17 Nos has been discharged from the hospital & remaining 7 Nos are receiving treatment at the hospital

v. Unit has submitted the interim Environment Damage Compensation (EDC) of Rs. 51,03,100/- to the Board and also submitted the payment acknowledgement to the board through mail.

vi. Unit has submitted details of paid Compensation to all injured workers during the accident.

vii. Industry has submitted further DISH authority order dated: 08.01.2024 & 13.05.2024 showing to permission to restart the operation of the Plant No. 1, Plant No. 3 and underground storage tank area, above ground tank area and all green, blue coloured area shown in site lay out plan as per DISH authority order dated: 13.05.2024.

ix. During visit ambient air quality found normal.

AND WHEREAS you have submitted notarized undertaking for compliance assurance of closure direction on 28.12.2023 along with assurance to comply with the any directions given by the Hon'ble NGT in the matter of O.A. No. 718 of 2023.

AND WHEREAS you have paid the 100% interim EDC amount of Rs. 50 Lakhs dated: 01.12.2023 (Transaction ID-VIC0215000873321) as imposed in closure direction.

AND WHEREAS In compliance of Hon'ble NGT directions in the matter of Original Application No. 220 of 2023 (WZ) you have submitted Environmental Damage assessment report from reputed Technical institute i.e. NEERI, which showing final amount of environmental Damage Compensation is Rs. 11,93,561.7/- and there is no challenged made by you against Interim EDC amount levied by the Board.

Outward No: 311618 18/05/2024

GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,
GANDHINAGAR - 382010,
(T) 079-23232152

AND WHEREAS you have submitted the Bank Guarantee (BG) No. 0052NDL0502225 dt. 05-12-2023 of ICICI Bank, valid upto 31.12.2024 for compliance assurance.

Under the above circumstances I, Dr. S. N. Agravat (Unit Head, Surat), Gujarat Pollution Control Board, is directed **revoke the closure order** issued vide letter No. GPCB/CCA-SRT-2000(61)/ID-45359/259063 dated: 20.11.2023 **for the three months** w.e.f. following conditions

1) Unit shall comply with the undertaking dated: 25.12.2023 & unit shall obey any direction issued by Hon'ble NGT in the matter of O.A. No. 218/2023
2) Unit shall comply with DISH direction order dated: 08.04.2024 & 13.05.2024
3) **Unit shall carry out only 75% quantity of consented production in the area/plant permitted by DISH authority in their direction dated: 08/04/2024 & 13/05/2024**

This order is issued after approval of competent authority.

For and on behalf of
Gujarat Pollution Control Board,

Dr. S. N. Agravat
Unit Head, Surat

NO: GPCB/CCA-SRT-2000(61)/ID: 45359/

Issued to:

M/s. Aether Industries Ltd.
Plot No. 8203, GIDC Sachin - 394230,
Tal: Olpad, Dist: Surat.

Copy To:

1. Regional Officer,
   Central Pollution Control Board,
   Plot No. E-5, 2nd Floor,
   GIDC Pandesara,
   Surat - 394221 ..... for verification of compliance & to submit report for further revocation of the bank guarantee.

TRUE COPY ADVOCATE

Outward No:811616, 08/05/2024