

**BEFORE THE NATIONAL GREEN TRIBUNAL
WESTERN ZONE BENCH, PUNE**

ORIGINAL APPLICATION NO. 2 OF 2025 (WZ)

Shri Ashutosh KumarAppellant

Versus

Gujarat Flurochemicals Ltd & Ors.Respondents

**AFFIDAVIT ON BEHALF OF GUJARAT POLLUTION
CONTROL BOARD**

I, Mukesh R Macwana, adult, having my office address at Paryavaran Bhavan, Sector 10A, Gandhinagar, do hereby solemnly affirm and state an oath as under:

1. I am presently serving as Senior Environment Engineer with Gujarat Pollution Control Board. I have perused the record pertaining to the case available in my office and am conversant with the facts of the case. I am authorized to swear the present affidavit on behalf of the Gujarat Pollution Control Board and am otherwise competent to make the present affidavit.
2. I am filing the present affidavit to bring on record the details regarding the unfortunate gas leak incident which occurred on 28.12.2024 in the premises of the respondent



no. 1 and the steps taken thereafter for proper remediation.

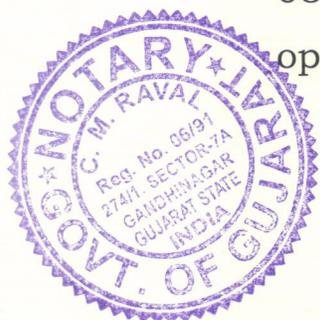
3. I say that the Board has submitted a Joint Committee Report before this Hon'ble Tribunal (page 582 onwards) in compliance with order dated 13.01.2025 and the same is not being annexed herewith to avoid duplicity. I say that the Joint Committee after a comprehensive investigation has concluded that the cause of action for the said incident was the lack of monitoring of the bad condition of fitted valves by the respondent no. 1 unit which led to the leakage. The leakage from the isolation valve claimed the life of four persons who died in the unfortunate incident and caused injuries to two other persons. As found by the Joint Committee, the unit has now remedied the cause of accident by replacing the isolation valve and by connecting the pipeline after proper decontamination. The unit engaged one M/s Rollscoax India Private Limited, an agency approved by Director Industrial Safety and Health, Government of Gujarat for carrying out inspection, testing and certification of the equipment. The agency has certified that the equipment was found to be safe for use as per the tests conducted by them after the remediation work carried out by the unit.

4. The unit has paid an *ex-gratia* compensation of Rs. 40,00,000/- each to the legal heirs of the deceased persons and Rs. 12,50,000/- each as compensation under the Employees' Compensation Act, 1923.



5. I say that as far as the action taken by the Board is concerned, immediately on receiving the information about occurrence of the incident, the Board conducted a site inspection on 29.12.2024. On 03.01.2025, the Board issued Direction to the unit under Section 31A of the Air (Prevention and Control of Pollution) Act, 1981 calling upon them to immediately stop the operation of the plant and enquire into the root cause of the incident as well as submit the Hazard and Operability Study Report ('HAZOP'). The Board called upon the unit to report compliance of change of isolation valve and resolve the cause of the accident. The Board further levied interim Environment Damage Compensation to the tune of Rs. 1 crore on the unit and called upon them to furnish a bank guarantee of Rs. 10,00,000/-.

6. I say that the unit has submitted a compliance report of the recommendations made in the HAZOP Study. Largely, the unit has complied with the recommendations made in the HAZOP Study and has undertaken on affidavit to comply with all the recommendations made in the Study. A copy of HAZOP Report is annexed herewith and marked as **Annexure R-1**. I say that the unit has deposited the amount of interim Environmental Damage Compensation and the bank guarantee on 06.01.2025. I say that subsequent to deposit of such amount and after monitoring the status of compliance, the Board issued an order dated 17.01.2025 revoking the Direction dated 03.01.2025 and permitted the unit to commence operations.



7. I say that the Board shall continue to monitor the unit and assures that it shall abide by all or any order that are issued by this Hon'ble Tribunal.

DEPONENT

VERIFICATION

Verified at Gandhinagar on this 28th day of July, 2025 that the contents of the above affidavit are true and correct, nothing stated therein is false and nothing material has been concealed therefrom.

DEPONENT

**SOLENNY AFFIRMED
BEFORE ME**

(C. M. RAVAL)
NOTARY
GOVT. OF GUJARAT

28-7-2025

Entered in Notary Register at
Serial No. 325 Vol. No-I
C. M. RAVAL ADVOCATE & NOTARY
GANDHINAGAR

28-7-2025
28-7-2025



HAZARD AND OPERABILITY STUDY REVIEW FOR CMS-1 PLANT



Gujarat Fluorochemicals Limited

Dahej, Gujarat



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 GFL [®] <small>GUJARAT FLUOROCHEMICALS</small> <small>VALUE THROUGH GREEN CHEMISTRY</small>	HAZARD AND OPERABILITY STUDY REVIEW FOR CMS-1 PLANT		 <small>Progress with Eco Balance</small>	
	<small>HSE ref. no.</small> 728.01.620	<small>Doc. No.</small> 728.01.620-RP-HAZOP-CMS-1	<small>Rev.</small> A	<small>Date</small> 09/01/2025

Client: Gujarat Fluorochemicals Limited

Project: Hazard and Operability Study Review for CMS-1 Plant

Project No.: 24-728.01.620-gfl-dhj-hazop



09-01-2025	A	Draft Report	SS	SS	YSG	
Date	Rev	Remarks / Revision Summary	Prepared	Checked	Approved	Approved By
			HSE RMSPL			Client

REVISION RECORDS

	HAZARD AND OPERABILITY STUDY REVIEW FOR CMS-1 PLANT			
	HSE ref. no. 728.01.620	Doc. No. 728.01.620-RP-HAZOP-CMS-1	Rev. A	Date 09/01/2025

DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of Gujarat Fluorochemicals Limited and is subject to and issued in accordance with the contract between Gujarat Fluorochemicals Limited and HSE Risk Management Services Private Limited. HSE Risk Management Services Private Limited accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party. Copying this report without the permission of GFL is not permitted.

	HAZARD AND OPERABILITY STUDY REVIEW FOR CMS-1 PLANT			
	HSE ref. no. 728.01.620	Doc. No. 728.01.620-RP-HAZOP-CMS-1	Rev. A	Date 09/01/2025

ACKNOWLEDGEMENT

We express our sincere thanks to management & employees of “Gujarat Fluorochemicals Limited” for their co-operation and unstinted help without which the study & report on “**HAZARD AND OPERABILITY STUDY REVIEW FOR CMS-1 PLANT**” could not have been possible. The courtesy extended to our team is highly appreciated.

For HSE RMSPL



AUTHORISED SIGNATORY

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ABBREVIATIONS

HAZOP Study	Hazard and Operability Study
MSDS	Material Safety Data Sheet
NA	Not Applicable
P & ID	Piping & Instrumentation Diagram
PPE	Personal Protective Equipment
PFD	Process Flow Diagram
SOP	Standard Operating Procedures
DCS	Distributed Control System
NRV	Non-Return Valve

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EXECUTIVE SUMMARY

Upon request, a Hazard and Operability Study Review (HAZOP Study) was carried out for Gujarat Fluorochemicals Limited 'CMS-1 Plant'.

The objective of the study was to identify and evaluate potential hazards and operability problems and concerns and, where possible, develop recommendations for the mitigation or elimination of such identified issues or concerns. The purpose of a HAZOP is to identify hazards and operability related concerns (and not necessarily to solve them) and this was kept foremost in the minds of the members of the multidisciplinary team.

The detailed HAZOP worksheets are presented in Appendix-A. These provide a complete record of the deliberations.

The HAZOP study was based on typical project P&IDs (see Appendix-B) provided by Gujarat Fluorochemicals Limited.

This report consists of findings from HAZOP Study for the Project activity. This HAZOP Review session was conducted on 07/01/2025 on the MS Teams. The session was chaired by Mr. Yashpal Singh & Sarvesh Sharma and Scribed by Miss Shalini Singh in presence of multidisciplinary teams from Gujarat Fluorochemicals Limited. Brainstorming session was conducted with constructive participation and contribution by all team members.

There were **30 P&ID** that were undertaken for HAZOP Study, in which total **31 nodes** were decided, **567 deviations** were listed, **601 Causes** were identified with respect to which **437 Consequences** were analyzed

Risk Ranking is evaluated in two Levels

- Risk Ranking Carried with Safeguard
- Risk Ranking Carried after Recommendation

Team discussed and agreed to perform the HAZOP study based on **31 nodes** for the project scope of work and has given **190 independent recommendations**.

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Place(s) Used	Recommendations	Responsible Person / Dept	Priority	Status
Cat: 1.1.29.1.1.1	1. Perform regular sampling of Hot Oil for Methanol content to identify tube leakage	Process	R3	Closed
Cat: 1.2.22.1.1.1	2. Review the Chemical compatibility of Hot Oil at supply temperature with HCL	Process	R3	Closed
Cat: 1.6.21.1.1.1	3. Review closed sampling system from V-2105 bottom valve	Technical Cell	R3	Closed
Cat: 1.9.17.1.1.1	4. Regular sampling (once on two weeks) of methanol to check for MDC content	Process	R3	Closed
Cat: 1.13.44.1.1.1	5. Regular inspection of all RDs	Engineering	R1	Closed
Cat: 1.15.47.1.1.1	6. Regular planned inspection of tubes.	Engineering	R3	Closed
Cat: 1.16.11.1.2.1, 1.16.11.2.2.1, 1.16.22.1.2.1, 1.16.35.1.2.1, 1.16.36.1.2.1	7. Ensure system is in place as part of Onsite Emergency Response plan to control & contain gaseous mixture at Incident location (like use of multiple fire water monitors and multiple Mayura curtains), thereby minimizing onsite and offsite environment impact to minimum level	Process / Safety	R4	Closed
Cat: 1.16.21.1.1.1	8. Provide PAH on steam line set at 9 kg/cm ²	Technical Services	R2	Closed
Cat: 1.16.21.1.1.1, 1.16.37.1.1.1	9. Provide high Pressure alarm on PIC 2832, set point to be kept at level not exceeding normal operating pressure T- 2202 bottom	Inst	R2	Closed
Cat: 1.16.28.1.1.1	10. Recommended to close LV-2212 on LALL	Inst	R3	Closed
Cat: 1.16.36.1.1.1, 1.16.36.1.2.1	11. Identify PSM Critical equipment list and develop MI Program	Engineering	R3	Closed
Cat: 1.16.36.1.1.1, 1.16.36.1.2.1	12. Ensure Comprehensive MIQA plan	Engineering	R3	Closed

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Place(s) Used	Recommendations	Responsible Person / Dept	Priority	Status
Cat: 1.28.27.1.1.1	13. Prevent Exposure of T-2404 to direct sunlight.	Process	R3	Closed

Legend: Place(s) used for recommendations are given references for easy reference as mentioned below: E.g.: 1.1.2.3.4

1st digit indicates the Project; 2nd digit indicates the Node;

3rd digit indicates the Deviation; 4th digit indicates the Causes;

5th digit indicates the consequences

CONCLUSION

HAZOP Study were performed for the CMS-1 Plant at Gujarat Fluorochemicals Ltd., As per the IEC 61882:2001 "Hazard and operability studies (HAZOP studies) - Application guide. This study concluded with a total of 190 recommendations.

Close all the recommendations, i.e., the 13 recommendations within the defined time period.

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1. INTRODUCTION

1.1. COMPANY PROFILE

GFL is a leading producer of Fluoropolymers, Fluorospecialities, Refrigerants and Chemicals for applications in varied industries. GFL derives its strength from expertise in Fluorine Chemistry, vertical integration from natural minerals to Fluoropolymers and strong R&D, enabling it to provide one of the best quality products meeting all regulatory compliances, to our clientele globally.

The year 1989 marked commencement of Company's commercial operations with India's largest Refrigerant manufacturing unit at Ranjitnagar, Gujarat, India. The site was further expanded to produce Fluorospeciality products catering to the growing demands in global agriculture and pharmaceutical industry. Foraying into new avenues in 2007, with one of the world's most integrated facilities at Dahej, Gujarat, India, GFL now has a diverse portfolio of Fluoropolymers comprising PTFE, PFA, FEP, FKM, PVDF and Fluoropolymer Additives.

With three manufacturing facilities in India, a captive Fluorspar mine in Morocco, offices and warehouses in Europe and USA, and a marketing network spread across the world, GFL is one of the established players in Fluoropolymers and Fluorospecialities markets.

GFL Sustainability goals are interwoven with the way we do business all along our value chain. The company is signatory to the United Nations Global Compact (UNGC), and is a member of the Indian Chemical Council (ICC). GFL focus on Health, Safety and Environment is reflected in the wellbeing and safety of their people.

1.2. OBJECTIVE

To identify the hazards and Operability problems and to reduce the likelihood and/or Consequence of an incident that would have detrimental impact to the personnel, plant, environment.

1.3. SCOPE

Scope of the Study is limited to CMS-1 Plant located at Gujarat Fluorochemicals Limited, Dahej, Gujarat.

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1.4. PROCESS DESCRIPTION

S.NO.	Node Description and Intent
1.	Methanol Feed preheating
2.	HCL Feed Preheating
3.	Hydrochlorination Reactor
4.	Hot oil circulation system
5.	Quenching and Dehydrating Section
6.	CH ₃ Cl compressor system
7.	CH ₃ Cl Condenser and transferring system
8.	21% HCL Tank System
9.	Methanol Storage
10.	Chlorine vapor from vaporizer to R-2201
11.	CH ₃ Cl evaporator E-2201
12.	CH ₃ Cl feed preheater to Reactor R-2201
13.	-Thermal Reactor section -Emergency vessel -Quenching tower and heating system
14.	Condensation and recycle section
15.	Condensation and recycle section
16.	Recycle column system
17.	Distillation system
18.	CH ₂ Cl ₂ Azeotrope system
19.	CHCl ₃ distillation
20.	CHCl ₃ Azeotrope system
21.	CH ₂ Cl ₂ Check Tank

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S.NO.	Node Description and Intent
22.	CHCl ₃ Check Tank
23.	Residue system
24.	CCl ₄ Distillation system
25.	CCl ₄ Drying and Product checking system
26.	HCl Absorber System
27.	Organic Stripper System
28.	HCl Scrubber System
29.	31% HCl tank system
30.	Cold CH ₂ Cl ₂ system
31.	Sulfuric acid tanks system

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2. HAZOP METHODOLOGY

2.1. HAZOP Concept

The HAZOP process is based on the principle that a team approach to hazard analysis will identify more problems than when individuals working separately combine results. The HAZOP team is made up of individuals with varying backgrounds and expertise. The expertise is brought together during HAZOP sessions and through a collective brainstorming effort that stimulates creativity and new ideas, a thorough review of the process under consideration is made.

2.2. HAZOP Process

The HAZOP team focuses on specific portions of the process called "nodes". Generally, these are identified from the P&ID of the process before the study begins. A process parameter is identified, say flow, and an intention is created for the node under consideration. Then a series of guidewords is combined with the parameter "flow" to create deviations. For example, the guideword "no" is combined with the parameter flow to give the deviation "no flow". The team then focuses on listing all the credible causes of a "No flow" deviation beginning with the cause that can result in the worst possible consequence the team can think of at the time. Once the causes are recorded the team lists the consequences, safeguards and any recommendations deemed appropriate. The process is repeated for the next deviation and so on until completion of the node. The team moves on to the next node and repeats the process.

2.3. HAZOP Steps

The analysis develops through logical exercise by associating guide words and process/safety parameters in order to identify potentially hazardous situations in terms of causes, effects, and countermeasures.

A detailed list of the main steps of the analysis follows, together with a sample of guidewords and process/safety parameters to be used in developing the logical phase of the study. The list of deviations used in this HAZOP Study is listed in Section 2.1.

The following sequence of activities is implemented during the HAZOP Review study:

- a) Select a Node, which contains an elementary unit of the plant.
- b) Define the Node design intent and process conditions.
- c) Apply the first Parameter to the node such as Flow, Pressure, Temperature, Level, Composition, etc.
- d) Apply suitable Guide Word such as more, less, etc.
- e) Obtain a meaningful Deviation by combining Guideword and Parameter, e.g., more flow.

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- f) Identify the potential and credible Causes associated with the Deviation by brainstorming.
- g) Assess the Consequences of each cause.
- h) Identify Safeguards included in the design to prevent and/or mitigate the hazard.
- i) Agree a Recommendation for action if the existing safeguards are found to be inadequate. If an immediate solution is available and acceptable to the team, the modification is recorded in the HAZOP worksheet and HAZOP master P&ID will be marked up accordingly. Where solutions are unlikely to be derived without a technical evaluation, the Chairman will refer the problem for separate assessment.
- j) Repeat the above procedures to the next guideword (move to step d) until these guidewords have been completed.
- k) Repeat the above procedures to the next parameter (move to step c) until these parameters have been completed.
- l) Move to the next node (go to step a) of the process system. All process systems will be examined this way by the team.

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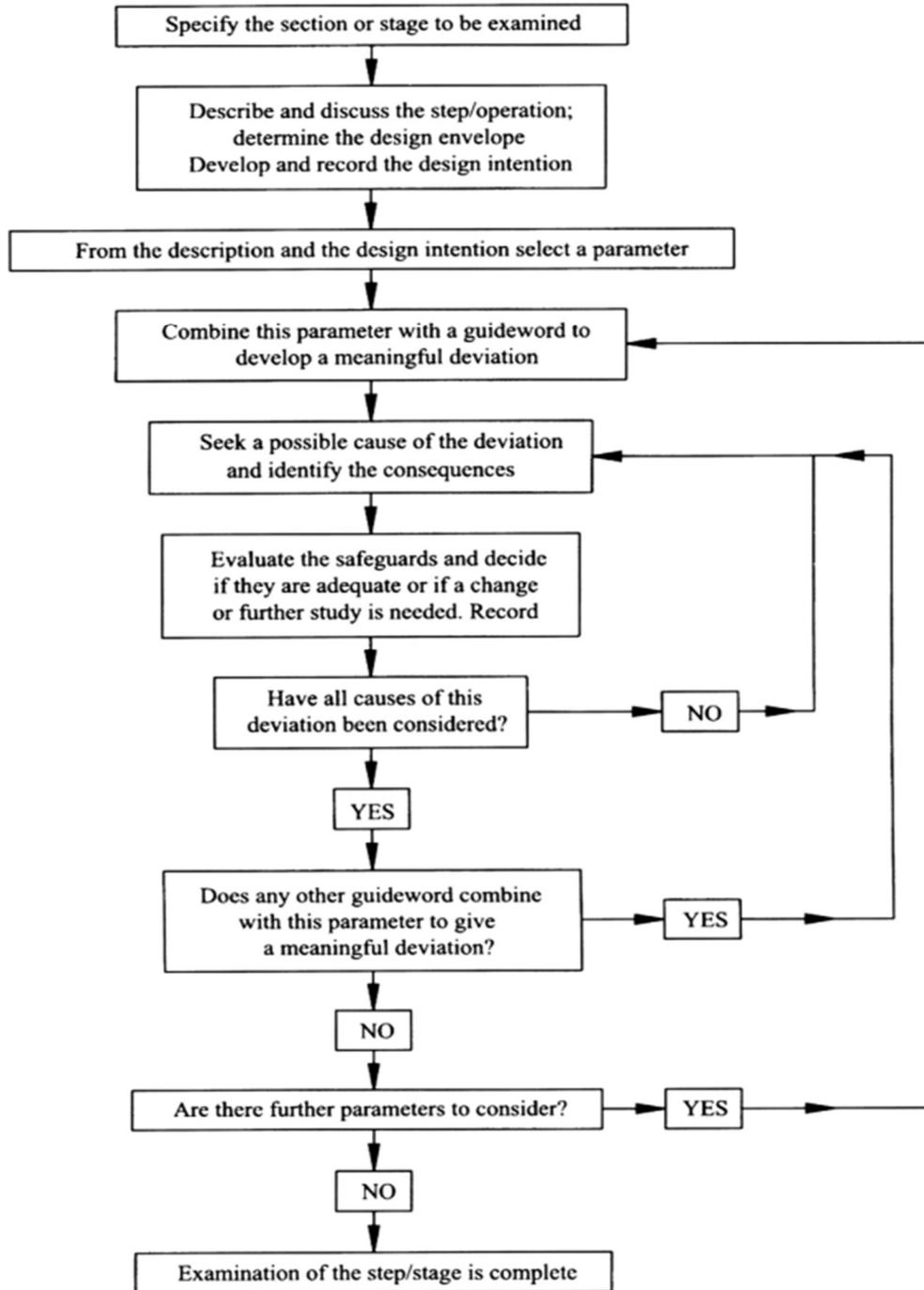


Figure 2.3-1 HAZOP Methodology Flow sheet

2.4. Philosophy – Hazard v/s Operability Study

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HAZOPs concentrate on identifying both hazards as well as operability problems. While the HAZOP study is designed to identify hazards through a systematic approach, more than 80% of study recommendations are operability problems and are not, of themselves, hazards. Although hazard identification is the main focus, operability problems should be identified to the extent that they have the potential to lead to process hazards, result in an environmental violation or have a negative impact on profitability. A definition of hazard and operability is given below.

2.5. Definitions

Hazard - potential source of harm.

Operability-Any operation inside the design envelope that would cause a shutdown that could possibly lead to a violation of environmental, health or safety regulations or negatively impact profitability.

Study Nodes -The Node is the portion of the plant subject to the study, where single or limited process functions are assigned. The HAZOP Chairman identifies nodes for the comment of the HAZOP team. A reference number will identify the selected node. The team will identify the intention of the node and major process conditions will be recorded.

Even if the nodes will normally include one or more equipment and the connected lines, HAZOP analysis will be based on "line-oriented approach": deviations from normal process parameters will be identified on process lines; equipment issues will be then included as results of the analysis in the cause / consequence identification process.

Parameters -The usual parameters applied to all nodes are Pressure, Temperature and Composition. Additional parameters are Flow, Level, etc. These additional parameters may be required by the nature of each node.

Guidewords- word or phrase which expresses and defines a specific type of deviation from an element's design intent.

Deviations - departure from the design intent.

Specific deviations to be considered due to the peculiarity of a node will be agreed by the HAZOP team and used when required.

Causes- The HAZOP team finds most causes of a deviation using brainstorming. The cause/consequence identification process on a node will be as much "linear" as possible. If no possible causes are identified state "no causes identified" on the HAZOP worksheet and start a new deviation. The most probable causes will be identified and discussed. When not specifically needed, discussions longer than 10 minutes will be avoided. If the HAZOP team is not able to come

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to an agreement about a cause or a consequence, a note will be taken on the HAZOP worksheet in order to plan further investigation by involved specialists.

Consequences -The potential consequences of each deviation are discussed and assessed within the limits of the information available and the expertise of the team.

The potential consequences threat must be assessed not considering operator or instruments intervention or any mitigation or safeguards. Consequences will be basically focused on possible major effects in terms of health and safety.

Safeguards -HAZOP team will investigate / identify effective safeguards to prevent or control the hazard. The team will discuss if there are adequate levels of protection for the identified hazard and record them on the worksheet.

Recommendations-The HAZOP team will provide recommendations if the existing protective measures are found to be inadequate, so that the situation is improved. If an immediate solution is available and acceptable to the team, the modification is recorded in the HAZOP worksheet and the HAZOP master P&ID will be marked up accordingly. Where solutions are unlikely to be derived without a technical evaluation, the Chairman will refer through a recommendation the problem for separate assessment. Resulting modifications (recommendations) will be evaluated during the HAZOP Follow-Up activities.

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3. Guidelines

The HAZOP Study was carried as per IEC 61882:2001 "Hazard and operability studies (HAZOP studies) - Application guide".

3.1 Deviation

The applicable guidewords were finalized based on the system characteristics and HAZOP Leader's experience. List of deviations that have been used during this HAZOP Study workshop:

1. No/Less flow
2. More flow
3. Reverse flow
4. Misdirected Flow
5. As well as Flow
6. More Pressure
7. Less Pressure
8. High level
9. Low level
10. More Temperature
11. Less Temperature
12. More/ Less Viscosity/pH
13. Other Than Flow/ Contamination/ Composition/ Concentration
14. Less / No Agitation
15. Utility Failure
16. Power Failure
17. Mechanical Failure / Leakage
18. Startup/Shutdown Hazards
19. Incompatible fluid (Reactor vessel / jacket, seal, HE etc.)
20. Fire / Explosion Personal Protection Hazards
21. Personal Protection Hazards
22. Others

3.2 Software Used

The HAZOP Session was documented using Process Hazard Analysis Software (PHA Pro v8), which aligns with industry Standard. All recommendations were recorded in the worksheets. The

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worksheets were projected onto a screen to allow the team to monitor progress and to facilitate agreement on the information recorded.

3.3 Risk Matrix

Evaluation and assessment of risk are carried out by taking both potential consequence of the hazard and the frequency of the hazard into considered. The frequency & consequence are qualitatively assessed using the risk matrix provided below:

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Consequence					Risk Assessment Matrix (Risk Ranking = Consequence Rating x Probability Rating)				
Rating	People Injury	Asset Losses (INR)*	Environment Impact*	Reputation*					
5	Multiple Fatality	Business interruption more than 1 months or Loss of > Rs.500 Lakh	Release causing impacts that justifies interrupting operations for an extended period of time or with potential human health or ecological impacts Significant agency action that limits operations	External reputation (Irreversibly) damaged	5	10	15	20	25
4	Single Fatality or multiple Lost Work Day Case (LWC)	Business interruption less than 1 month or Loss of Rs.100-500 Lakh	Release causing measureable impact(s) on ecological receptors and/or the public Regulatory response including investigation	External reputation severely damaged, considerable efforts & expenses required to recover.	4	8	12	16	20
3	Lost Workday Case (LWC)	Business interruption less than one week or Loss of Rs.50-100 Lakh	Reportable release to the environment Regulatory response including orders, Violations, and/or fines	External reputation damaged, Some effort & expense required to recover	3	6	9	12	15
2	Medical treatment Case (MTC)	Business interruption less than one shift or Loss of Rs.10-50 Lakh	Non Reportable release to the environment Regulatory response excluding orders, Violations, and/or fines.	External reputation minimally affected, little effort or expense required to recover	2	4	6	8	10
1	Minor/ First aid injury	No Business interruption or Loss of < Rs.10 Lakh	Localized release contained within the building No regulatory exceedance	External reputation not affected, No effort or expense required to recover	1	2	3	4	5
Probability					1	2	3	4	5
					Highly unlikely	Unlikely	Possible	Likely	Almost Certain
					Never Heard of in the Industry	Heard in Industry 10 ⁻³ -10 ⁻⁴ /yr.	Happened in the Org. 10 ⁻² -10 ⁻³ /yr.	Happened at the Site >10 ⁻² /yr.	Has happened at the site >1/yr.

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1	Level 1	16 to 25	Intolerable	Develop recommendations to bring risk level immediately to level 3 or 4
2	Level 2	10 to 12	Undesirable (Needs Action)	Develop recommendations to bring risk level to 3 or 4
3	Level 3	4 to 9	Tolerable with controls	Team may suggest recommendations to bring risk level to 4
4	Level 4	1 to 3	Tolerable As is	Opportunity for improvement

SEVERITY CRITERIA				
Rating	People Injury	Asset Losses (INR)*	Environment Impact*	Reputation*
5	Multiple Fatality	Business interruption more than 1 months or Loss of > Rs.500 Lakh	Release causing impacts that justifies interrupting operations for an extended period of time or with potential human health or ecological impacts Significant agency action that limits operations	External reputation (Irreversibly) damaged
4	Single Fatality or multiple Lost Work Day Case (LWC)	Business interruption less than 1 month or Loss of Rs.100-500 Lakh	Release causing measurable impact(s) on ecological receptors and/or the public Regulatory response including investigation	External reputation severely damaged, considerable efforts & expenses required to recover.
3	Lost Workday Case (LWC)	Business interruption less than one week or Loss of Rs.50-100 Lakh	Reportable release to the environment Regulatory response including orders, Violations, and/or fines	External reputation damaged, Some effort & expense required to recover
2	Medical treatment Case (MTC)	Business interruption less than one shift or Loss of Rs.10-50 Lakh	Non-Reportable release to the environment Regulatory response excluding orders, Violations, and/or fines.	External reputation minimally affected, little effort or expense required to recover
1	Minor/ First aid injury	No Business interruption or Loss of < Rs.10 Lakh	Localized release contained within the building No regulatory exceedance	External reputation not affected, No effort or expense required to recover

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LIKELIHOOD CRITERIA		
	Score	Probability
Highly Unlikely	1	Never heard of in the industry
Unlikely	2	Heard in the industry 10 ⁻³ to 10 ⁻⁴ /yr
Possible	3	Happened in the organization 10 ⁻² to 10 ⁻³ /yr
Likely	4	Happened at the site >10 ⁻² /yr
Almost Certain	5	Has happened at the site >1/yr

3.4 Assumptions

Table 3-1 List of Assumptions

Sr. No.	Assumption	Place used
1.	Workers and operators are trained and experienced to operate the plant safely.	Entire report
2.	All the PIDs used in this HAZOP Study are latest and updated	Entire report

Category for Classifying Flammable Material:

Flammable Liquids vary in volatility and have a flash point below 93°C and a Vapor Pressure not exceeding 2.81 kg/cm² at 37.8°C. These are divided into three classes, as follows,

Class A: Flammable liquids having flash point below 23° C

Class B: Flammable liquids having flash point 23° C and above but below 65°C

Class C: Flammable liquids having flash point 65° C and above but below 93°

Category for Classifying Toxic Material:

Chemicals having the following values of acute toxicity and which owing to their physical and chemical properties, are capable of producing major accident hazards:

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Sr. No	Degree of toxicity	(Medium lethal by the oral route toxicity) LD 50 (mg/kg body weight of test animals)	Medium lethal by the normal (dermal LD 50 body weight of test animals)	Medium lethal concentration by Inhalation route (Four hours) LC 50 (mg/1 Inhalation in test animals)
a)	Extremely toxic	1 – 50	1 – 200	0.1 - 0.5
b)	Highly toxic	51 – 200	201 – 2000	0.5 - 2.0

Category for Dust Explosion Test

No fire or explosion	St _{0H}
Dust fire or mild explosion	St _{1H}
Violent explosion	St _{2H}

Classification by Burning Test

No spreading of Fire	No ignition	1
	Brief ignition, rapid extinction	2
	Localized combustion or glowing without flame	3
Fire spreads	Glowing without sparks	4
	Slow quiet burning with flames	5
	Very rapid combustion	6

Specific Powder (Bulk) Resistivity:

Observation (Resistivity)	Inference
$<10^8$ ohm.m	Conductive
10^8 - 10^{10} ohm.m	Moderately Conductive
$>10^{10}$ ohm.m	Resistive

3.5 Cautions

Even the most rigorous HAZOP cannot be relied upon to foresee every hazard and some accidents may well occur in the future. When an incident occurs on a plant which has undergone a HAZOP study, several questions of particular significance should be asked:

- had the set of conditions (deviations) which led to the incident been considered by the HAZOP study team? If not, could the team reasonably have been expected to have done so? and

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- if such deviations and their causes had been considered, had the team made a reasonable judgment of the likely frequency of the events and had concluded that they were unlikely to occur and thus posed 'acceptable risks'?

In such circumstances it is clearly important to document all the outcomes of study in order to answer these questions.

HAZOPs are an essential tool for hazard identification and have been used successfully to improve the safety and operability of both new and existing chemical plant. The technique is not confined to the chemical and pharmaceutical industries and has also been used successfully in several other industries, including the offshore oil and food industries.

3.6 List of Participants

The HAZOP Study members consisted of representative of Gujarat Fluorochemicals Limited. The HAZOP Study was chaired by independent chairman along with Scribe, engaged by HSE Risk Management Services Private Limited on 07/01/2025. Attendance Sheet is attached as Appendix-C for Reference.

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4. STUDY ELEMENT

4.1. NODE LIST

The Node list for the HAZOP Study is shown in Table 4.1

Table 4.1-1 List of Node

Node	Node Description and Intent	List of P&IDs	Major Equipment
32.	Methanol Feed preheating	1308-7001-L102	E-2102 and E-2104
33.	HCL Feed Preheating	1308-7001-L102	E-2103
34.	Hydrochlorination Reactor	1308-7001-L103	R-2101
35.	Hot oil circulation system	1308-7001-L103	P-2102A/B/C, E-2107, R-2101 shell, S-2101, V-2102, Y-2101, V-2108
36.	Quenching and Dehydrating Section	1308-7001-L104	T-2101, S-2103, E-2108, S-2101, S-2102, D-2101, T-2104, D-2102, P-2106A/B, E-2113
37.	CH ₃ Cl compressor system	1308-7001-L106 Sht-1 of 2 and 1308-70	V-2105, C-2101A/B and V-2107
38.	CH ₃ Cl Condenser and transferring system	1308-7001-L107	E-2115, V-2106A/B, S-2104, E-2116-1, E-2116-3, P-2107A/B, E-2118
39.	21% HCL Tank System	1308-7001-L105 1308-7001-L406	E-2110A/B, V-2403A/B, P-2403A/B
40.	Methanol Storage	1308-7001-L101	V2101A/B, P-2101A/B, P-2109, E-2101
41.	Chlorine vapor from vaporizer to R-2201	1308-7001-L201	V-2206, M-2201

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Node	Node Description and Intent	List of P&IDs	Major Equipment
42.	CH ₃ CL evaporator E-2201	1308-7001-L201	E-2201,D-2201
43.	CH ₃ Cl feed preheater to Reactor R-2201	1308-7001-L201	E-2202A/B
44.	-Thermal Reactor section -Emergency vessel -Quenching tower and heating system	1308-7001-L202	-R-2201,Y-2201 -V-2201 -T-2201, E-2212A/B,V-2205A/B,
45.	Condensation and recycle section	1308-7001-L203	-E-2203, E-2204,D-2202, V-2202, P-2201A/B/C, P-2203A, S-2201, S-2202,E-2211
46.	Condensation and recycle section	1308-7001-L203 1308-7001-L204	E-2205,E-22022,E-2203 S-2203,V-2203,P2202A/B
47.	Recycle column system	1308-7001-L205 1308-7001-L203	T-2202,E-2206,E-2207,E-2208,E-2209,V-2204,P-2204B
48.	Distillation system	1308-7001-L203	S-2306, V-2301,P-2301A/B, T-2301-1, T-2301-2,P-2312A/B, E-2301,E-2302,E-2303,E-2304,E-2305,E-2306,S-2301
49.	CH ₂ Cl ₂ Azeotrope system	1308-7001-L303	E-2311,S-2302,E-2307,E-2312,P-2303A/B,P-2304A/B,E-2309,T-2302,E-2308
50.	CHCl ₃ distillation	1308-7001-L-304	S-2307,V-2304,E-2318,T-2303-1,T-2303-2P-2313A/B,E-2315A,E-2314A/BP

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Node	Node Description and Intent	List of P&IDs	Major Equipment
51.	CHCl ₃ Azeotrope system	1308-7001-L-306	E-2322,E-2319,S-2304,P-2308A/B,T-2304,E-2320,E-2321
52.	CH ₂ Cl ₂ Check Tank	1308-7001-L-307	V-2302A/B,P-2305A/B,Dryer,E-2310
53.	CHCl ₃ Check Tank	1308-7001-L-308	V-2305A/B,P-2310A/B,E-2323
54.	Residue system	1308-7001-L-310	V-2310A/B,P-2317A/B,V-2307,P-2311A/B
55.	CCl ₄ Distillation system	1308-7001-L311 2308-7001-L312	T-2305,V-2308A/B,E-2325,P-2316A/B, E-2326A/B/C, S-2305 ,E-2327, P- 2314A/B
56.	CCl ₄ Drying and Product checking system	1308-7001-L313 1308-7001-L314	E-2331, S-2308,P-2318A/B, P-2319A/B, S-2309A/B, V-2311A/B,P-2320A/B,E-2332
57.	HCl Absorber System	1308-7001-L401	E-2401,E-2402,V-2401,P-2401A/B
58.	Organic Stripper System	1308-7001-L402	T-2402,T-2403,E-2403,D-2401
59.	HCL Scrubber System	1308-7001-L403	T-2404, P-2405A/B/C, V-2405, E-2406
60.	31% HCl tank system	1308-7001-L405	V-2402A/B/C, N-V-2402D, P-2402A/B, V-2404, P-2404A/B, T-2401
61.	Cold CH ₂ Cl ₂ system	1308-7001-L822	E-2821-1,E-2821-3,P-2821A/B,V-2822
62.	Sulfuric acid tanks system	1308-7001-L407	V-2701,V-2702, P-2701, P-2702,P-2706

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4.2. HAZOP Recording

The discussion is recorded on various worksheets according to project sections studied. Information is recorded in columns on the worksheets as follows:

- a. Deviation;
- b. Causes;
- c. Consequences;
- d. Safeguards;
- e. Risk Ranking
- f. Recommendations
- g. Category

Once identified, it is necessary to analyze the hazard determining whether it poses significant risk and requires risk reduction/mitigation/management. The acceptability of the estimated risk must then be judged based on GFL Risk criteria, considering particular situation.

5. RECOMMENDATIONS

The HAZOP team made its recommendations based on the information available and provided to the team during the study, and on the knowledge and experience of the team members. However, all of the recommendations offered for consideration must be thoroughly reviewed from an engineering and operational viewpoint to ensure that the identified hazard is detected, prevented, or mitigated, and additional hazards are not created by implementing the recommendation.

For more details Refer Appendix A HAZOP Worksheet.

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6. REFERENCES

- a. Project documents like P&IDs & SOP
- b. MSDS of Raw Materials & Product
- c. IEC 61882:2001 "Hazard and operability studies (HAZOP studies) - Application guide"

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APPENDIX – A
HAZOP REVIEW WORKSHEET
(NUMBERS OF SHEETS-265)

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APPENDIX – B
P&IDS
(Number of P&ID-30)

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APPENDIX – C
ATTENDANCE SHEET
(NUMBER OF SHEET - 1)

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