BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,
WESTERN ZONE BENCH, PUNE
APPEAL NO. 5 OF 2021

SANGHAR ZUBER ISMAIL ... APPELLANT

VERSUS

MINISTRY OF ENVIRONMENT, FORESTS
AND CLIMATE CHANGE AND ANR. ... RESPONDENTS

WRITTEN SUBMISSIONS ON BEHALF OF RESPONDENT NO. 2
(NAYARA ENERGY LTD.)

1. The Appellant has filed the present Appeal challenging the EC dated 05.01.2021 (the "EC") [Annexure-A – Page 10 of Paper-Book] granted by Respondent No. 1 (MOEF&CC) to Respondent No. 2 (Nayara Energy Ltd.) the subject matter of the Appeal is the expansion of refinery capacity Respondent No. 2 which is currently operating a 20 MMTPA refinery complex at Vadinar, Devbhumi Dwarka, Gujarat. The investment made in the refinery complex till date is Rs. 51,000 crores. The project currently provides employment to 1800 employees and 4500 contract persons which include local population. The total amount spent by Respondent No. 2 on CSR is 80 crores in the past five years.

2. Under the expansion plan, the capacity of the refinery shall be increased from 20 MMTPA to 46 MMTPA. The cost of investment for the expansion project is Rs. 1,30,000 crores. The total amount to be utilized for environmental pollution control measures is 3923 crores with a recurring cost of Rs. 30.4 crores annually. The employment to be

generated by the expansion is about 2000 persons directly and 12,000-15,000 persons indirectly. The project area is spread over 2275 Ha of land. No additional land will be acquired for the expansion. The project already has about 410 Ha of green belt in the existing refinery. Additional 340 Ha of green belt will be developed along-side the expansion. This will result in 33% of the total 2275 Ha of project area being developed and maintained as green belt. A sum of Rs. 74.58 crores is proposed to be allocated annually towards CSR depending upon financial performance of Respondent No. 2.

3. The Appeal was listed before this Hon'ble Tribunal on 31.05.2021. Counsel for Respondent No. 2 appeared on caveat and pointed out that copy of the Paper-Book has not been provided to Respondent No. 2 as Caveator. After allowing Respondent No. 3 to obtain a copy, this Hon'ble Tribunal proceeded to hear the matter. Submissions made on behalf of the Appellant and Respondent No. 2 was heard and judgment/order was reserved. The Appellant and Respondent No. 2 were permitted to file written submissions. These Written Submissions are being filed on behalf of Respondent No. 2 in terms of the above-mentioned. After the hearing was concluded, Respondent No. 2 was provided with a copy of the Appeal by the Appellant.

4. It is pertinent to note that submissions were made on behalf of Respondent No. 2 without the benefit of referring to the Appeal since copy was not served as stated above. After the hearing was over, upon perusal of the Appeal, it was discovered that the Appeal consists of merely 4 (four) sketchy and vague grounds [Page 5 of Paper-Book]. Moreover, it also came to light that the EIA Report annexed to the Appeal [Annexure-C at Page 20 of Paper-Book] is a different EIA Report which relates to the Asset Development Project-1 of Respondent No. 2. The EC dated

05.01.2021 under challenge in the present appeal was issued in respect of the expansion project for which a separate EIA Report was prepared and submitted. This crucial fact has not been pointed out by the Appellant and a wrong EIA Report was relied upon by the Appellant in order to mislead this Hon'ble Court.

Copy of EIA Report for Expansion of Refinery from 20 MMTPA to 46 MMTPA is annexed as **Annexure-1**.

5. At the very outset, it is required to be pointed out that the Appellant has not alleged in the Appeal that the Respondent No. 2 existing project is causing any pollution or violating any norms or conditions of the clearances available with Respondent No. 2. The case of the Appellant is based upon pure conjectures and surmises that the expansion will have adverse impact on the ecology of the area. However, the Appellant has failed to disclose any material upon which its case is founded. On the contrary, Respondent No. 1 while issuing the EC has considered all the aspects which are a subject matter of the present Appeal.

6. In addition to dealing with the grounds raised in the Appeal, Respondent No. 2 seeks to put forth the submissions below, which will demonstrate that the Appeal deserves to be dismissed at first stage with cost.

I. SUPPRESSION OF MATERIAL FACTS

7. The Appellant has suppressed several material and crucial facts in the Appeal. The Appellant has suppressed the fact that the buffer zone of the Marine National Park has already been notified by Notification dated 22.08.2013. The refinery and the crude oil tank areas fall outside the boundaries of the Eco Sensitive Zone set out in the Notification.

Copy of Notification dated 22.08.2013 is annexed herewith as **Annexure-2.**

8. The Appellant has also suppressed that the existence of mangrove ('cher') jungle has been duly adverted to and considered in the EIA Report. The existence of the Marine National Park as an ecologically sensitive area as well as existence of the mangrove forest has been clearly enumerated and duly covered in the EIA Report. Since the expansion project falling within the purview of the EC has no impact upon on the mangrove forests at all, the issue of any adverse effect does not arise.

9. Moreover, the Appellant has also raised a wholly misconceived ground [Ground 5.2 – Page 5 of Paper-Book] that the discharge of 573 MLD of water will have adverse effect on the mangrove forest and the coral and coral reefs. While doing so, the Appellant had suppressed the fact that Special Condition (iv) of the EC [Page 13 of Paper-Book] clearly states that the entire 573 MLD (536.5 MLD + 36.5 MLD) of water 'will be sent for deep sea discharge through diffuser recommended by National Institute of Oceanography' ("NIO"). Thus, the issue of discharge of water has already been considered by Respondent No. 1 in the EC and Respondent No. 2 will duly comply with the requirement. The case of adverse impact set up by the Appellant is, therefore, not only erroneous but also premature.

II. EC IS SUBJECT TO SEVERAL CONDITIONS IMPOSED UPON RESPONDENT NO. 2

10. The EC contains a series of conditions under the category 'Specific Conditions' [Paragraph 13 of EC – Page 13 of Paper-Book] which Respondent No. 2 has to abide by while carrying out the expansion project. In addition, EC

contains clear description of the scope and extent of the project which demonstrates that all aspects relating to the project have fairly disclosed and discussed in the EIA Report. Therefore, all aspects relating to the proposed expansion have been duly taken into consideration by Respondent No. 1 while granting the EC.

III. VAGUENESS OF APPEAL AND MISLEADING GROUNDS

11. The contents of the Appeal are highly sketchy and the grounds are vague and misleading. This is a deliberate attempt on the part of the Appellant to mislead this Hon'ble Tribunal and agitate grounds and raise issues outside the scope of the Appeal. It is a settled position of law that pleadings which suffer from vagueness and are bereft of crucial facts and details required for proper adjudication deserve to be rejected. Besides the Respondent No. 2 reiterates that the Appeal is devoid of reasons, material facts and particulars and vague, vexatious and ought to be dismissed for want of cause of action.

IV. PROJECT SITE OUTSIDE THE ECO-SENSITIVE ZONE OF MARINE NATIONAL PARK AND FOREST AREA

12. As stated above, the Eco Sensitive Zone of the Marine National Park has already been notified by the Notification dated 22.08.2013 and the refinery and the crude oil tank areas fall outside its boundaries. In this regard it is extremely important to note that the Deputy Conservator of Forest, Marine National Park, Jamnagar has issued a letter dated 14.12.2020 to Respondent No. 2 which contains a categorical conclusion that the refinery and crude oil tank area falls outside the eco-sensitive zone of the Marine National Park.

Copy of letter dated 14.12.2020 is annexed as **Annexure-3.**

13. The Appellant has relied upon Notification dated 09.07.1976 [Annexure-D at Page 530 of Paper-Book] to contend that the project site falls within the areas notified under the above-mentioned Notification. However, the project site does not fall under any of the areas notified in the Notification. In any event, this aspect has already been considered by Respondent No. 1. Special Condition (i) of the EC [Page 13 of Paper-Book] stipulates that the EC is subject to obtaining prior clearance from the wildlife angle including clearance from the Standing Committee of National Board for Wildlife, as applicable, as per OM dated 08.08.2019.

V. ALLEGED VIOLATION OF CRZ REGULATIONS

14. The Appellant has not raised any ground or averment in the Appeal regarding violation of CRZ Regulations. However, during the hearing dated 31.05.2021 before this Hon'ble Tribunal, the Appellant raised this issue. Be that as it may, Respondent No. 2 seeks to point out that with respect to the infrastructure/ facilities which supports the refinery at the existing capacity viz., jetty, approach to jetty, SBM and crude and product pipeline Respondent No. 2 duly applied for and obtained CRZ Clearance dated 03.11.2000.

Copy of CRZ Clearance dated 03.11.2020 is annexed as **Annexure-4.**

15. The Appellant has neither made out any case in its pleadings nor placed any material on record to demonstrate that Respondent No. 3 has violated any of the conditions specified in the CRZ Clearance. Therefore, such bald assertions ought to be summarily rejected.

VI. MONITORING MECHANISM

16. As a part of compliance of Condition No. B, General Condition No. (v) of the above-mentioned CRZ Clearance issued to Respondent No. 2, NIO annually conducts detailed investigation in respect of water quality, sediment quality and biological characteristic of coastal area of Vadinar to assess the impact of ongoing activities of Respondent No. 2 on marine ecology as well as to assess the general health of corals and mangroves of intertidal sites at Vadinar. In addition, this monitoring mechanism also suggest mitigation measures for maintaining a healthy marine ecosystem around the project site which Respondent No. 2 has been regularly following. The monitoring is being regularly updated and reports are being duly submitted by Respondent No. 2.

17. The above-mentioned robust monitoring mechanism has already been put in place respect of the project of Respondent No. 2 through the CRZ Clearance obtained by Respondent No. 2. Respondent No. 2 is bound to comply with and is scrupulously complying with all the conditions imposed by the CRZ Clearance with regular reporting. Thus, there is no requirement for separate monitoring suggested by the Appellant.

18. In terms of submissions made in the paragraphs above, the Appeal deserves to be dismissed with costs.

SRDangare

Pune

Date: 05.06.2021

Ms. Supriya Dangare

(Advocate for Respondent No. 2)

"Annexure 1"

Final Report

EIA/EMP Study for Setting up of Asset Development Project -1 at Vadinar, Dist. Devbhumi Dwarka, Gujarat

(Volume 1)

For

M/s Nayara Energy Ltd.

CSIR-National Environmental Engineering Research Institute (NEERI), Delhi Zonal Centre, Naraina, New Delhi 110028
Head Quarter - Nehru Marg, Nagpur 440 020

(QCI/NABET Accreditation letter no. QCI/NABET/ENV/ACO /18/0592 dated March 15, 2018)

April 2020

True Copy
Swayam

Final Report

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April 2020

Foreword

M/s Nayara Energy Ltd., erstwhile Essar Oil Ltd., is operating a 20 MMTPA refinery complex at Vadinar, Devbhumi Dwarka, Gujarat. It is the second largest single location Refinery in India and is also among the top 5 most complex refineries in the world. The company continues to strive for excellence with its strengths, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability. In addition, it has a strong retail network of about 4,900 fuel stations catering to different parts of the country. The network is being further expanded with about 2600 more retail stations in near future.

M/s Nayara Energy has applied for environmental clearance for expansion of Refinery from 20 MMTPA to 46 MMTPA along with 10.75 MMTPA Petrochemical Complex, EC for which is under consideration at MoEF&CC.

The present proposal "Asset Development Project-1 (ADP-1)" is a small part of the total Refinery Capacity Expansion Project, and involves production of 450 KTPA polypropylene (PP) by revamping FCC Unit and unsaturated LPG Treating Unit of the existing refinery. The revamping will also bring some changes in the product slate of the existing refinery, however the total crude throughput shall remain same (20 MMTPA). Since, this project is a part of the total Refinery Capacity Expansion Project, the baseline data collected for the Refiney Expansion Project during Summer 2018 has been used for this ADP-1 Project. Proposed ADP-1 Project shall take place at the land available within the existing refinery premises.

With a view to assessing potential impacts arising out of the proposed Polypropylene Plant and revamping of FCCU, M/s Nayara Energy Limited, the project proponent approached CSIR-NEERI to conduct environmental impact and risk assessment (EI&RA) study as a prelude to the preparation of effective environmental management plan (EMP).

Baseline data collected for air, noise, water, biological, land and socio-economic components of the environment during Summer 2018 has formed the basis for identification, prediction and evaluation of impacts due to the proposed developments, as also for the delineation of a pragmatic environmental management plan in this EIA Report. The other available environmental attributes have also been assessed while evaluating the changes and its possible impacts within the ambit of project.

This exercise couldn't have been possible to accomplish without the adequate cooperation and assistance rendered by the staff of Nayara Energy Limited in the preparation of this report. Their on-ground support and providing of information in time were of immense help which CSIR NEERI team appreciates.

(Rakesh Kumar)
Director, CSIR-NEERI

Nagpur
April, 2020

Project Personnel

CSIR-NEERI Team involved in Refinery Capacity Expansion Project

Component	Functional Area Expert (QCI/NABET) / Scientific Staff	Team Member/ Project Assistants
Air Environment		
Meteorology, Air Quality Monitoring & Prediction (AQ)	Dr. S.K. Goyal Dr. Sunil Gulia	Mr. Amit Kumar Mishra Ms. Pratyushpingita Mishra Ms. Prachi Goyal
Air Pollution Monitoring Prevention and Control (AP)	Dr. S.K. Goyal Dr. Sunil Gulia Dr. Mamta Prakash	
Noise Environment		
Noise & Vibration (NV)	Dr. G. L. Bodhe Mr. Satish Lokhande	Mr. Mohinder Jain
Water Environment		
Water Pollution Monitoring, Prevention Control (WP)	Dr. Amit Bansiwal Dr. Mamta Prakash Dr. Noor A. Khan Mrs. Priyanka Saxena	Mr. Amit Kumar Mishra Ms. Pratyushpingita Mishra Mrs. Usha Tripathi Mrs. Neha Yadav Mr. Deep Chand Mr. Sourabh Mr. Ravi Prakash
Land Environment		
Land-use (LU)/ Soil Quality	Dr. Ritesh Vijay Dr. Mamta Prakash	Mr. Amit Kumar Mishra Ms. Pratyushpingita Mishra Ms. Tridipa Biswas
Solid & Hazardous Waste Management (SHW)	Dr. M. Suresh Kumar	
Biological Environment		
Ecology and Biodiversity (EB)	Dr. Kanchan Kumari Dr. Mamta Prakash Mrs. Rashmi Dixit Dr. M. Suresh Kumar	Ms. Jyoti Tagde Ms. Ruchita Haldar Ms. Pratyushpingita Mishra Mr. Amit Kumar Mishra
Socio-economic		
Socio-economic Aspects (SE)	Mr. Sanjay Bodhale Dr. S.K. Goyal	Mr. Amit Kumar Mishra Ms. Pratyushpingita Mishra
Geo & HG	Dr. Raghuvanshi Ram	Ms. Tridipa Biswas
Risk Assessment (RA)	Dr. Santosh Ghuge	Mr. Sagar Karande Ms. Ashoo Kale
EIA Coordinator/ Project Leader	Dr. S.K. Goyal Dr. M. Suresh Kumar	
Overall Guidance	Dr. Rakesh Kumar Director	

Project Personnel

CSIR-NEERI Team

ADP-1 Project Report Preparation

Dr. S. K Goyal, EIA Coordinator

Dr. Sunil Gulia, Sr. Scientist

Dr. Santosh Ghuge, FAE, RA

M/s. Nayara Energy Limited (Formerly Essar Oil Limited)

Mr. Shyama Maji, Senior Vice President – Head - Technical
Mr. Sudhir Singh, Vice President - Project
Mr. Manish Raj, General Manager - Utilities and Offsites
Mr. P.R. Dixit, Vice President & Head HSEF
Mr. P.K.Srivastava, Vice President – Head Project, Asset Development
Mr. Avinash Chaturvedi, Advisor
Ms. Asmita Patel, Head - Environment

DISCLAIMER

The information contained in the report is based on the scientific analysis of data/ information / drawings provided by the Project Proponent as also collected from other sources during the time of the study. While efforts have been made to ensure accuracy of information in the report, CSIR-NEERI shall not own, in any manner, any legal, financial or consequential responsibility for any event of occurrence of any accident/hazard or direct or indirect damage/loss to any third party or to the Project Proponent due to the use or inability to use the information contained in the report.

The Project Proponent shall exercise due dilligence and make their own decision to implement the contents of the report. The report shall not be construed as any guarantee or warranty from CSIR-NEERI.

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Acronyms and Abbreviations

˚C	degree Celsius
µg/m^3	Microgram cubic meter
AAS	Atomic Absorption Spectroscopy
ACF	Activated Carbon Filter
ALARP	As Low As Reasonably Practicable
APHA	American Public Health Association
ARU	Amine Regeneration Unit
As	Arsenic
ASHA	Accredited Social Health Activist
ATM	Automated Teller Machine
BCC	Behaviour Change Communication
BOD	Biochemical Oxygen Demand
CAGR	Compound annual growth rate
CCR	Continuous Catalytic Reformer
CDU	Crude Distillation Unit
CEC	Cation Exchange Capacity
CFU	Colony-forming unit
CFD	Computational Fluid Dynamics
CHP	Cumene hydroperoxide
CO	Carbon Monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
COT	Crude Oil Terminal/Tankages
CPCB	Central Pollution Control Board
CR	Critically Endangered
CSR	Corporate Social Responsibility
DAO	Deasphalted Oil
DCU	Delayed Cracker Unit
DD	Data Deficient
DEG	Di Ethylene Glycol
DHDS	Diesel Hydro De Sulphurisation
DHDT	Diesel Hydro Treater
DIH	Deisohexanizer
DMF	Dual Media Filter
DMP	Disaster Management Plan

EMARC	Environmental Management Apex Review Committee
ESP	Exchangeable Sodium Percentage
ETP	Effluent Treatment Plant
EVA	Ethylene-vinyl acetate
FC	Faecal Coliform
FCCU	Fluidized Catalytic Cracking Unit
FGD	Focused Group Discussions
FPU	Feed Preparation Unit
GCERT	Gujarat Council for Education, Research, and Training
GDP	Gross domestic product
GDS	Gasoline Desulphurisation
GIDC	Gujarat Industrial Development Corporation
GIS	Geographic Information System
H_2S	Hydrogen Sulphide
ha	Hectare
HDA	Hydro de-alkylation
HDPE	High-density polyethylene
HDS	Hydro Desulphurisation
HMU	Hydrogen Manufacturing Unit
HNO_3	Nitric Acid
HSD	High Speed Diesel
HSEQ	Health, Safety, Environment and Quality
ICP	Inductively Coupled Plasma
IFA	Indian Forest Act,1927
IIPHG	Indian Institute of Public Health Gandhinagar
ILabss	Integrated Lab for soft-skills development
INR	Indian Rupee
IR	Individual Risk
ISOM	Isomerisation Unit
IUCN	International Union for Conservation of Nature
KL	Kilolitre
Km	Kilometres
Km/hr	Kilometres per hour
km^2	Square Kilometre
KOD	Knock Out Drum
KTPA	Kilo-Tonnes Per Annum

LAB	Linear Alkyl Benzene
LC	Least Concern
LCO	Light cycle oil
Leq dB (A)	Equivalent Sound Level in decibels for Human Hearing
lg	Locally gregarious
LLDPE	Linear low-density polyethylene
LPG	Liquid Petroleum Gas
LULC	Land use and land cover
m/s	Metre per second
MCM	Million Cubic Metres
MEG	Mono Ethylene Glycol
mg/l	Milligram per litre
MLVSS	Mixed Liquor Volatile Suspended Solid
MMTPA	Million Metric Tonne Per Annum
MoEF&CC	Ministry of Environment Forest and Climate Change
MTBE	Methyl Tertiary Butyl Ether
MUG	Make Up Gas
Na^+	Sodium
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing and Calibration Laboratories
ND	Not Detected
NEERI	National Environmental Engineering Research Institute
NGO	Non- Governmental Organization
NH_3	Ammonia
NH_4^+	Ammonium
NHT	Naphtha Hydro Treater
Ni	Nickel
NIO	National Institute of Oceanography
NO_2	Nitrogen Dioxide
NO_3^-	Nitrate
NPG	Neo Pentyl Glycol
NRSC	National Remote Sensing Centre
NTU	Nephelometric Turbidity Unit
OC	Organic Carbon
OP	Pyrolyzed carbon fraction
Pb	Lead

PC	Personal computer
PDH	Propane dehydrogenation
PE	Polyethylene
PET	Polyethylene Terephthalate
PEVA	Poly ethylene-vinyl acetate
pH	Potential of Hydrogen ion
PHC	Primary Health Centre
PIT	Product and Intermediate Tankage
PM	Particulate Matter
PM_{10}	Particulate Matter size <10 microns
$PM_{2.5}$	Particulate Matter size <2.5 microns
PO	Propylene Oxide
PO_4^{-2}	Phosphate
PP	Polypropylene
PPE's	Personal Protective Equipment
PRT	Power Recovery Turbines
PRU	Propylene Recovery Unit
PSA	Pressure Swing Adsorption
psia	Pounds per Square inch absolute
psig	Pounds per Square inch, gauge
PTA	Purified terephthalic acid
PTP	Pre Treatment Plant
PX	Paraxylene
QoL	Quality of life
RCC	Reinforced Cement Concrete
RET	Rare Endangered and Threatened
RF	Radio Frequency
SAP	Super Absorbent Polymer
SBM	Single buoy mooring
SC	Schedule Caste
SCOT	Shell Catalytic Off gas Treatment
SDA	Solvent Deasphalting Unit
SGU	Saturated Gas Unit
SHG	Self – Help Group
Sn	Tin
SO_2	Sulphur Dioxide

SO_4^{-2}	Sulfate
Sp	Species
Sp/m^3	Species per cubic metre
Sp/mL	Species per millilitre
SPM	Single point mooring
SPU	Sulphur Palletization Unit
Sr	Strontium
SRT	Short Residence Time
SRU	Sulphur Recovery Unit
SSOT	Single Stage, Once Through
ST	Schedule Tribe
STP	Sewage Treatment Plant
SWDI	Shannon Wiener Diversity Index
SWS	Sour Water Stripper
TDP	Toluene Disproportionation
TDS	Total Dissolved Solids
ToR	Term of References
TPI	Tilted Plate Inceptor
TSS	Total Suspended Solid
UOP	Universal Oil Products
USD	United States Dollar
USDA	United States Department of Agriculture
V	Vanadium
VAM	Vinyl Acetate Monomer
vc	Very common
VGO MHC	Vacuum Gas Oil Mild Hydrocracker
VLCCs	Very Large Crude Carriers
VOC's	Volatile Organic Compounds
VU	Vulnerable
WBM	Water bound macadam
WHB	Waste Heat Boiler
WHO	World Health Organization
Zn	Zinc
ZnO	Zinc Oxide

Executive Summary

Executive Summary

1.1 Background

M/s Nayara Energy Ltd., erstwhile Essar Oil Ltd., is operating a 20 MMTPA refinery complex at Vadinar, Devbhumi Dwarka, Gujarat. It is the second largest single location Refinery in India and is also among the top 5 most complex refineries in the world. The company continues to strive for excellence with its strengths, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability.

In addition, it has a strong retail network of about 4,900 fuel stations catering to different parts of the country. The network is being further expanded with about 2600 more retail stations in near future.

Further, M/s Nayara Energy has earlier applied for environmental clearance for expansion of Refinery from 20 MMTPA to 46 MMTPA along with 10.75 MMTPA Petrochemical Complex vide online proposal no. IA/GJ/IND2/119511/2018 Dtd 2nd June 2018. ToR was issued TOR on 3rd Aug 2018, and EIA/EMP studies were conducted accordingly. Final Report was submitted to the MoEF&CC on October 15, 2019 and the project was appraised in 17st EAC meeting held on Feb 26, 2020, wherein the committee advised to conduct public hearing at the project site. Subsequently, M/s Nayara Energy approached GPCB for the same, and public hearing was scheduled for May 1, 2020. But, due to COVID 19 pandemic all across the world, the public hearing has been called off till the normalcy is attained in the Country and State also.

In light of above, Nayara Energy, in its immediate business plan towards expansion into petrochemicals, desires to set up a 450 KTPA Polypropylene plant, which will produce 450 KTPA polypropylene, a new product for Nayara. This will be achieved by suitably modifying/revamping existing FCC Unit and existing Unsat LPG Treating Unit and addition of Propylene Recovery Unit (PRU). This project has been named as ***"Asset Development Project-1 (ADP-1) of Nayara Energy"*.**

As per the Environmental Impact Assessment (EIA) Notification dated 14th September 2006 read with amendments, the proposed expansion of project falls under Category A with project or activity type '4a' "Petroleum Refining Processes" and '5(c)' "Petrochemical complexes, which requires prior EIA for Environmental Clearance (EC) from the Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

It is pertinent to mention here that the present proposal number IA/GJ/IND2/ 149284/2020 for the Project "Asset Development Project-1 (ADP-1)" is a small part of the total Project for which earlier EC was applied for. In the earlier proposal, Propylene/ Polypropylene production of 2050 KTPA (1000+1050 KTPA) was planned, whereas in this project, it is 450 KTPA only. Since, this project is a part of the total Refinery

Expansion Project (EIA Report already submitted to MoEF&CC in October 2019), the baseline data collected for the Project during Summer 2018 has been used along with other relevant components as applicable.

The present EIA report addresses the environmental impacts of the proposed ADP-1 project, and proposes the mitigation measures for the anticipated impacts. The EIA report is prepared based on the standard ToRs issued by MoEF&CC, vide letter no. J-11011/86/2020-IA-II(I), dated April 18, 2020.

This is a small modernization project, where there is no change in crude throughput and there is no significant load on the environment and no furnace is proposed in these 2 units, effluent generated will be treated in existing unit, the project is requested to be considered under 7(ii) (a), exempting public consultation.

1.2 Justification of Proposed Project

1.2.1 Need for the Project (demand/supply gap) and its importance

Strategic Rational For Phase 1 (ADP-1) Project of Nayara

Program for ADP-1 project proposed to be undertaken by Nayara is based on the following main strategic considerations:

- **Product Diversification:** With volatility on crude and key fuel products, diversification to petrochemicals is becoming a necessity for pure refiners like Nayara.
- **Growing Indian Demand:** Indian petrochemical demand, especially for polymers is growing more rapidly than the rest of the world (Indian Polypropylene demand is estimated to grow at 8-9% CAGR). India have projected deficit of 1.2 million tonnes by 2022 as demand growth is outpacing capacity expansions. Proposed project is expected to get ready market in India in view of emerging deficit.
- **Cost Competitiveness:** Propylene is the basic petrochemical building block most suited for refinery; cheapest source for C3= is from FCC, and Nayara already has a large FCC which can be revamped for high severity to maximize C3= production and support a world scale PP unit.
- **Refinery Integration:** Nayara's refinery, leveraging its high complexity to process the cheapest and dirtiest crudes, can make the feedstock available for petrochemical production at very competitive costs; the cheap power and steam cost can help keeping the conversion cost for petrochemicals at relatively low levels.
- **Government Support:** Indian Government is promoting 'Make in India' to reduce dependency on imports

1.2.2 India PP Market Opportunity

- Petrochemicals play a vital role in the functioning of virtually all key sectors of economy which includes agriculture, infrastructure, healthcare, textiles and consumer durables. Polymers provide critical inputs which enable other sector to grow. Petrochemical products cover the entire spectrum of daily use items ranging from clothing, housing, construction, furniture, automobiles, household items, toys, agriculture, horticulture, irrigation, and packaging to medical appliances.
- Average annual incremental PP demand in India expected to be 540 KTPA during period of 2018 to 2022 which necessitates world scale capacity addition every year.
- High population, relatively low per capita consumption and expected high economic growth should propel India's polymer consumption to new levels in future. Historically demand of PP has grown at 1.5 times of GDP growth in India and it is expected to grow at minimum 8% per year in future. Current PP demand of 5.5 MMTPA (year 2019-20 estimate) is expected to reach 8.8 MMTPA by year 2025-26 with this 8% growth rate. This demand growth likely to create need of 3.0 MMTPA PP capacity addition in India by 2025.

Employment Generation due to the Project

The proposed ADP-1 project will provide direct/indirect employment to approx. 7000 persons during the peak construction phase and about 150 persons during operation.

1.3 EIA Study for the Proposed ADP-1 Project

1.3.1 Study Objective and Scope of Work

The main objective of the present study is to conduct Environmental Impact Assessment incorporating baseline environmental quality data of one season leading to identification, prediction and evaluation of impacts and suggest mitigation measures and environmental management plans for the proposed ADP-1project of Nayara Refinery as per approved Standard ToR.

Environmental baseline monitoring carried out during Summer 2018 for the Refinery Capacity Expansion Project with Petrochemical Complex has been used. Being a modernization project without change in crude throughput of 20 MMTPA, and also a very small part of the expansion project, this ADP-1 project is requested to be considered under EIA 2006 Notification clause 7 (ii)(a) for exemption in public consultation point of view.

1.3.2 Study Area Details

The study area for the present EIA study is the area covered within the 10 km radius from the centre of refinery premises. The refinery is located about 39 km from Jamnagar on SH-25, on the way to Dwarka in Gujarat State on West Coast of India. It is about 8-10 km from the sea front with central coordinate of refinery as; latitude 22°19'49.18" N and longitude 69°44'58.07" E. The site is situated at Vadinar village, Khambhalia Tehsil, Devbhumi Dwarka district, Gujarat. Nearest railway station is Jamkhambhalia, which is about 20 km and nearest airport is Jamnagar, which is about 30 km from the site.

As per 2011 Census, total population of the study area was 63171, out of which male population was 34694 (54.92%) and female population was 28477 (45.08%). Total geographical land area of the study area is 290.48 km^2 with population density of 217 persons/km^2. Total child population (below 6 years of age) was 8779 (13.90%). Sex ratio (number of females/1000 males) of the total population was 821. Overall literate population was 36546 (57.85%) and illiterate population was 26625 (42.15%).

1.3.3 Structure of the EIA Report

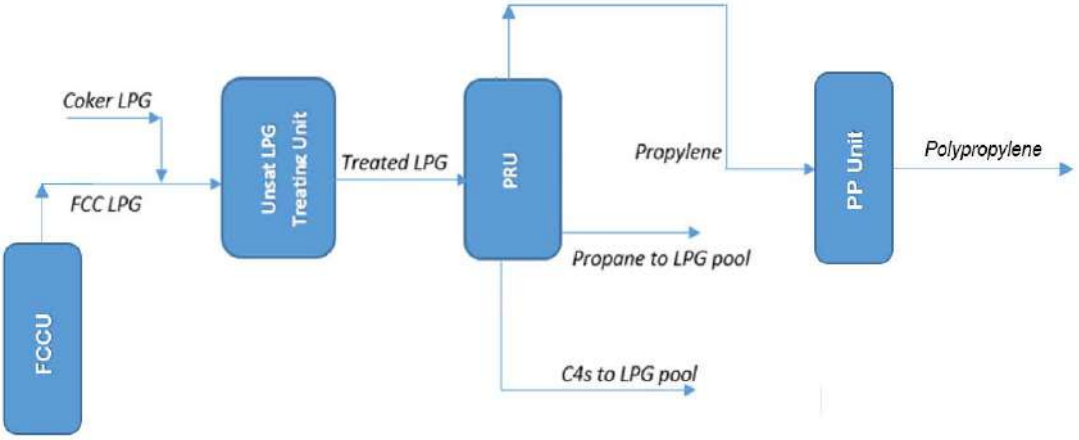
EIA study has been conducted as per the approved standard ToR and presented in the following Chapters as: Introduction, Project Description, Description of the Environment, Anticipated Environmental Impacts & Mitigation Measures, Analysis of Alternatives (Technology and Sites), Environmental Monitoring Programme, Additional Studies, Project Benefits, Environmental Cost Benefit, Environmental Management Plan and Summary & Conclusions, and Details of consultant

2.0 Project Description

Nayara Energy proposes to set up 450 KTPA (kilo tonne per annum) Polypropylene plant. The primary source of feedstock is its existing FCC Unit, which will be revamped to boost its performance to produce high propylene in FCC LPG stream. As a part of revamp there will be modifications in Reactor internals and columns internals, addition of few exchangers and pumps etc. to existing units. This LPG, after mixing with DCU LPG, will go to existing Unsat LPG Treating Unit which is also to be revamped. The treated LPG, post caustic treatment, will be routed to a new Propylene Recovery Unit (PRU) to recover Propylene, which subsequently will be sent to the new Polypropylene Plant to produce polypropylene which is a new product for Nayara.

The existing "Environment Clearance" has expired in Sep'18 and hence new "Environment Clearance" for the above mentioned project is being sought. This project is named as Asset Development Project-1 (ADP-1).

A representative Schematic of proposed unit is given below:



The salient features of the existing and proposed ADP-1 project with requirement of major inputs resources are summarized in **Table 2.1**.

Table 2.1: Salient Features of the Existing and Post ADP-1 Refinery Complex of M/s Nayara Energy Ltd.

Sr. No.	Features	Details
1.	Crude Processing Capacity	**Existing Refinery** : 20 MMTPA **Post ADP-1** : 20 MMTPA
2.	Project Cost for ADP-1	Rs. 6200 Crores
3.	Cost of EMP for ADP-1	Rs. 10 Crores
4.	Total Project Area	40 Ha
5.	Water Requirement	**Existing Refinery** - 204 MLD Sea Water **Post ADP 1** – 221.3 MLD Sea Water (Existing facilities shall suffice the new requirement)
6.	Waste water generation and disposal to sea	**Existing Refinery** - Process effluent – 26 MLD, Saline water discharge – 134 MLD **Post ADP 1** – Process effluent – 27.1 MLD, Saline water discharge – 144.9 MLD
7.	Power Requirement	**Existing Refinery** - 160 MW by CPP **Post ADP 1** – 199 MW by CPP (Existing facilities shall suffice the new requirement)
8.	Air Emission (No. of Stacks)	**Existing Refinery** -17 Nos. **Post ADP 1** – 18 Nos. All Stacks are/will be provided with appropriate air pollution control system/measures.
9.	Hazardous Waste Management	Hazardous waste is/shall be handled as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
10.	Employment Generation	**Existing Refinery** - 1500 Nos. **Post ADP 1** - 1650 Nos. Contract workers during construction phase : 7000

3.0 Description of the Environment

3.1 Air Quality Status

In order to establish background levels of air quality in the study area (10 km radius area of the proposed refinery), monitoring was carried out at nine locations during Summer 2018. Four locations were within 5 km radius from the plant, whereas 4 locations were between 5 & 10 km radius from the plant and one represented the air quality status within the refinery complex.

All the 12 parameters indicated in the NAAQS were monitored, with two additional parameters; vanadium and hydrocarbons, specific to the refinery. The monitoring was carried out during Summer 2018 (April-June), with few observations taken during the month of March also. Parameters like PM_{10}, $PM_{2.5}$, Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_2) were monitored twice in a week, whereas other parameters like Carbon Monoxide (CO), Ammonia (NH_3), Hydrogen sulphide (H_2S), Lead (Pb), Arsenic (As), Nickel (Ni), Vanadium (V), Benzene, Benzo(α) Pyrene, Hydrocarbon, and Volatile Organic Compounds were monitored fortnightly. All the values were found mostly within the respective NAAQS, except few values of PM_{10} exceeding the limit occasionally, which may be attributed to rural background activities.

3.2 Noise Status

The noise monitoring was done at 12 residential locations/villages, 11 locations within and around the refinery complex and at highway near refinery gate during morning, afternoon, evening and night hours. Noise levels (Leq) measured in 12 different residential areas/ villages varied from 42-53 dB(A) during day time. The CPCB standard for day time noise level is 55 dB(A). The field observations during the study period indicate that the ambient noise levels at residential sites were well within the prescribed standards of CPCB. In rural areas, wind blowing and chirping of birds would contribute to noise levels especially during the daytime.

Noise levels within the refinery area were well within the stipulated noise standards of 75 dB(A) during the daytime. The computed average day-night sound pressure levels (Ldn) for 24 hours at refinery main gate was 66 dB(A) and noise level in the morning, afternoon, evening and night hours were observed between 67-74 dB(A). High levels of noise were attributed to the movement of vehicles along with intermittent honking by the vehicles on SH-25.

3.3 Water Quality Status

The baseline water quality status in the region was established by analysing samples from ground water (7 dug wells) and surface water (Phuljhar River and Sinhan

dam) sources within 10 km radius from the refinery. Besides, one sea water sample was taken from Vadinar jetty, which is about 12 km from the refinery. Also one sample was taken from the tanker, which supplies water to nearby water-scarce villages. Samples were also taken from the inlet and outlet of the Effluent Treatment Plant of the refinery. Water quality status in terms of various physico-chemical parameters, heavy metals and bacteriological parameters have been assessed for various water sources.

Phuljhar river is not a perennial river. Water sample was collected from stagnant water lying in the path of the river. Some of the water quality parameter like TDS, conductivity, chlorides, sulphates and sodium were found on higher side.

Refinery ETP outlet water is meeting the prescribed norms from Gujrat Pollution Control Board.

3.4 Soil Quality Status

As per 2011 Census, out of the total geographical area of about 29048 ha, about 56% area comes under Lalpur Tehsil, 36.4% under Khambalia Tehsil and rest 7.6% under Jamnagar. Net sown area is 57.8%. Forest area is only 0.1% (31.57 ha). Area under non-agricultural uses and culturable waste land is 7.1% and 2.4% respectively. Barren and un-cultivable lands are about 17.2%. The study area is covered with 6.3% permanent pasture and other grazing land. The total land under miscellaneous tree crops etc. land area is 2.4% of the total land area. Fallow land other than current fallows area, and current fallows area is 3.8% and 2.9% respectively.

As per remote sensing data (2016), landuse/ landcover (LULC) map was prepared for 10 km buffer of refinery (total area of about 314 km^2). Seven LULC classes were considered; i) agricultural land, ii) built-up land, iii) fallow land, iv) forest land, v) littoral swamp land, vi) wasteland and vii) water bodies. The analysis revealed that as much as 153.85 km^2 of the area was covered by fallow land, 75.25 km^2 of the area covered by wasteland, built-up land covered 32.85 km^2 and water bodies covered 31.35 km^2. Agricultural land covered 12.13 km^2, littoral swamp land covered 6.37 km^2 and Forest land covered only 2.36 km^2.

Soil samples were collected from eight villages within the study area and one sample was collected from green belt area of the refinery. Samples were analysed for various physico-chemical parameters, heavy metals and microbiological characteristics, following the Standard methods. The soils of the study area are moderately textured having sandy loam and sandy clay loam textural class in the impact zone.

Analysis of chemical properties data indicated that the soils were under the category of very high adsorptivity and moderate productivity. Overall fertility status of the soils revealed that the soils belonged to medium to fertile class.

3.5 Flora & Fauna

3.5.1 Baseline Status

The baseline status for biological environment has been established by assessing the distribution pattern, community structure and species composition of flora and fauna in and around existing refinery up to 10 km radius during Summer season, 2018.

In all, 20 sampling locations were identified for the collection of baseline data. Sampling locations were selected by random sampling technique and as per vegetation pattern present in the area. Visual observations and listing method for flora and fauna were carried out at the proposed site, forest patches, and agriculture fields and in several villages within the study area. The biological sampling locations for primary data survey were identified during site visit which includes nearby villages namely Zankhar, Timbdi, Mithoi, Bachelor Colony, Devaliya, Nayara Green and Nayara Building comes in close vicinity (0-5 km); whereas Singhach, Kajurda, Vadinar, Jogvad, Padana, Meghpar, Nana Mandha, Mota Mandha, Bharana and Rasangpur were situated far from proposed project site (5-10 km).

The sampling stations also comprised of two Reserved Forests; one was near Meghpar village and other was located near Sinhan Dam.

A complete list of plant species found in the study area representing different types of trees, shrubs, herbs, succulent plants, climbers and grasses was prepared.

Prosopis juliflora (Vilayati Babul) was observed as a dominant flora, widely spread all over the region. Natural vegetation of the study area comprises of trees species viz. *Acacia nilotica* (Desi babul), *Tectona grandis* (Teak), *Peltophorum pterocarpum* (Yellow flame), *Ficus relegiosa* (Peepal), *Cassia siamea* (Cassod tree), *Ficus bengalensis* (Banyan tree), *Luceana leucocephala* (Subabool), *Acacia auriculiformis* (Earleaf acacia), *Casuarina equisetifolia* (Whistling pine), *Pithecellobium dulce* (Jangali jalebi), *Pongamia pinnata* (Karanj), *Phoenix dactylifera* (Date palm), *Delonix regia* (Gulmohar), *Mangifera indica* (Mango), *Tamarindus indica* (Imli), *Butea monosperma* (Palash), *Azadirachta indic*a (Neem), *Sizygium cumini* (Jamun), *Eucalyptus species* (Nilgiri), *Ficus hispida* (Bokhedo), *Terminalia cattapa* (*Desi badam*), *Aegle marmelos* (Bel), *Ziziphus mauritiana* (Ber), etc. Some of the tree species were noticed along the agriculture field boundaries such as Neem, Date palm, Nilgiri, *Prosopis julifora*, etc.

Jamnagar Forest Department and the Refinery carried out plantation of *Delonix regia* (Gulmohar), *Tamarindus indica*, *Peltophorum pterocarpum*, *Bauhinia variegata* (Apta), *Tectona grandis*, *Alstonia scholaris* (Saptaparni), etc. on barren lands and along roadside.

The vegetation in the area harbours a variety of medicinal and aromatic plants. The survey conducted on medicinal plants includes the identification of medicinal plant species, plant part used and mode of healing properties. The medicinal plants observed in the study area were *Hyptis species, Lantana camara, Tridax procumbens, Azadirachta indica, Eucalyptus species, Butea monosperma, Emblica officinalis, Ziziphus mauritiana, Annona squamosa, Murraya koenigii, Aegle marmelos,* etc. *Opuntia stricta* has a great medicinal value and is considered as a potential source of natural red colourants. This plant with high water use efficiency produces forage for animals, vegetables, and fruits with glucose. Euphorbia tirucalli is also one of the important medicinal plants.

The main crops of the study area were Millet (Jowar), Bajari, Wheat, Groundnut and Cotton. Groundnut and cotton are important commercial crops, whereas wheat constitutes the irrigated crops. The other cash crops observed in the study area were: *Sessamum indicum* (Til), *Ricinus communis* (Castor), *Triticum aestavum* (Wheat), *Brassia compestris* (Mustard), *Zea mayz* (Maize), etc. and the fruits like *Musa paradisiaca* (Banana), *Carica papaya* (Papaya), *Psidium guajava* (Guava), *Manilkara zapota* (Chikoo), *Mangifera indica* (Mango), *Sizygium cumini* (Jamun), *Annona squamosa* (Sitaphal), *Cocos nucifera* (Coconut), etc. Some plants like *Citrus lemon* (Lemon), *Ziziphus jujube* (Ber), *Tamarindus indica* (Imli), *Emblica officinalis* (Amla) and Terminalia catappa (Desi Badam), were recorded in village area and in wild habitat within the project site area. In Jogvad village, plantation of Malabar Neem (*Melia dubia*) along with Chandan (*Santalum album*) plants as a mixed crop was observed in agriculture fields. Malabar Neem plant is grown by the villagers for plywood and pulp purpose.

Social plantations carried out by Nayara Energy Limited around the refinery areas and township include various ornamental plants like *Bauhinia variegata, Plumeria rubra, Roystonea regia, Casurina equisitifolia, Delonix regia, Caesalpinia pulcherrima, Nerium indicum, Polyalthia longifolia* and *Bougainvillea glabra*. Trees like *Acacia nilotica, Azadirachta indica, Alstonia scholaris, Albizzia lebbeck, Peltophorum pterocarpum* and *Delonix regia* were observed along the roadside for avenue plantation**.**

Faunal diversity was studied surrounding the 10 km radius area from the proposed site in Refinery complex. The study team observed various faunal species of Avifauna, Insects, Reptiles and Mammalian. The major ecosystems of the study area are water bodies (lakes & ponds), wastelands and agricultural lands. To study impact on biodiversity, the observations were taken at village area, agricultural sites, wasteland areas and water bodies.

As per management and working plan of Jamnagar District, mammals reported from the study site were Common Fox, Jackal, Nilgai, Wild Boar, Porcupine and Jungle Cat. Wild Hare was also reported to be present in the area as per information gathered from villagers in the study area. Common arboreal species reported are Indian Flying

fox/giant fruit bat and bonnet macaque. However, during the field studies, Monkey, Squirrel, Mongoose, Indian field mouse, etc. were observed in the study area. The domestic animals like Dogs, Cats, Cow and Sheeps were commonly found. The Herbivorous species found in the region were *Axix axix*, *Boselaphus tragocamelus*, *Funambulus pinnati*, *Sus scrofa*, *Lepus nigricolis*, *Macaca mulatla*, etc.

Vadinar area is an urbanized area and the most common bird species are Rock Pigeon, Jungle Crow, House Sparrow, Common Myna, Red vented Bulbul, etc. The avifauna observed during primary survey indicates a good diversity in the study area. The birds species observed were Little egret (*Egretta garzetta*), Great Egret (*Ardea alba*), Intermediate Egret (*Ardea intermedia)*, Pond Herons (*Ardeola grayii*), Greater Flamingo (*Phoenicopterus roseus*), Painted Stork (*Mycteria leucocephala*), Great blue heron (*Ardea herodias*), White-throated Kingfisher (*Halcyon smyrnensis*), Peafowls (*Pavo cristatus)*, Pigeons *(Columba domestica)*, Mynas *(Acridotheres tristis)*, Indian Robin (*Copsychus fulicatus*), Oriental magpie-robin (*Copsychus saularis*), Red-wattled lapwing *(Vanellus indicus)*, Laughing Dove (*Spilopelia senegalensis*), Green bee-eater (*Merops orientalis*), etc. The study area was dominated by the presence of Green bee-eater, Cattle egret, Black Drongo, Red-wattled lapwing, Black-winged stilt and Purple sunbird.

3.5.2 Ecologically Sensitive Areas

Marine National Park

It is India's first Marine National Park established in 1982. The marine sanctuary area has various species of hard & soft corals, prawns, sponges, crabs, turtles, water birds and brown, green & red algae. The Marine National Park & Sanctuary has coral reefs, mangroves, sea-grass beds, mudflats, network of creeks and other ecosystems which support rich marine life & bird life.

The Marine National Park & Sanctuary area has Coral Reefs, 37 species of Hard & Soft Corals, 70 species of Sponges, 27 species of Prawns, 30 species of Crabs, 200 species of Molluscs, Endangered Sea Turtles like the Green Sea, Oliver Riddley & Leather Back, Porpoise, Common Dolphins, Indo-Pacific bottlenose Dolphins and Indo-Pacific hump-backed dolphins. Also it supports growth of algae which comprises of 108 species of brown, green & red algae. Ray fishes which also include Sting Rays are all found in the marine national park. It has dense mangrove forests with Avicennia marina, Ceriops tagal, Aegiceras corniculatum & Rhizophora mucronata.

As per Forest Department, Jamnagar, two reserved forests also exists in the study area. One reserved forest is located near Sihan Dam, Danta village with survey no. 322/1. The total area covered in this forest is 87.66 ha. Another reserved forest is located near Meghpar Village and its survey no. is 155. This forest is spread in the 21.20 ha area.

Both the reserved forests prominently comprised of *Prosopis juliflora* (Junglee Kikar), and most of the species were stunted and bushy growth was observed. The other floral component consists of thorny bushes and variety of dried grasses. *Opuntia stricta* (Prickly Pear) was recorded in both the reserved forests. These Reserved Forests do not have any major plant species of rare and endangered or medicinally important plants and wildlife. Hence, there is no threat envisaged to the present biodiversity of the reserved forests from the proposed project activity.

3.5.3 Details of Green Belt Development

The Green Belt developed by Nayara Energy Limited has significant vegetation cover and plant diversity. As the region is dominated with dry thorny i.e. Scrub vegetation, Green belt has been developed in and around the refinery complex including avenue trees and gardens. The species selected include the species recommended as per CPCB guidelines, and some native species suitable to local climatic conditions are also planted. The tree species like *Dalbergia sissoo*, *Mangifera indica*, *Azadirecta indica*, *Pongamia pinnata*, *Acacia auroculoformis*, *Acacia nilotica*, *Ficus religiosa*, *Casurina equisetifolium* etc were planted in the green belt area. Tree species planted for avenue plantation are mainly evergreen plant species, like *Delonix regia*, *Cassia siamea*, *Polyalthia longifolia*, *Cocos nucifera*, *Baunia purphurea* etc.

Currently 20 MMTPA refinery is established in 1171 ha area, out of the total project area of 2275 ha. Well-maintained thick Green belt area with associated facilities has been developed in 410 Ha plant area (>33%) in the Refinery complex including COT area and Refinery-COT corridor area. Further, plantation/greenery shall be developed in the area surrounding the proposed ADP-1 project. Land Use pattern of the surrounding area will not be affected by the ADP-1 project activities, as these will be confined within the existing refinery premises.

Details of Horticulture Plantation in Refinery at Vadinar

Plantation has been carried out by Nayara Refinery over the years since its inception. Different plant species like Imli, Pomegranate, Mango, Sapota, Guava, Jamun and other forest species including Karanj, Alstonia, Tebubia, Peltophorum, Neem, Casurina etc. are planted. As observed, Casurina is one of the dominant plant species grown within the refinery as the plant is able to adapt to dry climate and is salt tolerant. The scale-light verticillate leaves and modified needle-like twigs help in reducing transpiration.

3.6 Socio-economic Status

The 10 km radius study area around Nayara Refinery lays under two districts; Jamnagar and Devbhumi Dwarka. The Devbhumi Dwarka district was carved out of the

Jamnagar district on August 15, 2013. Prior to this, the entire refinery complex was under Jamnagar district. Twenty-five villages in the study area come under three tehsils, namely Lalpur tehsil in Jamnagar (12 villages), Khambhalia tehsil in Devbhumi Dwarka (11 villages) and Jamnagar Tehsil (2 villages).

As per 2011 Census, total population of the study area was 63171, out of which male population was 34694 (54.92%) and female population was 28477 (45.08%). Total geographical area of the study area was 290.48 km^2 with population density of 217 persons/km^2. Total child population (below 6 years of age) was 8779 (13.90%). Total SC population was 4556 (7.21%), and ST population was only 260 (0.41%) in the study area. Sex ratio (number of females/1000 males) of the total population was 821.

Overall literate population was 36546 (57.85%) and illiterate population was 26625 (42.15%). Out of total literates, male literates were 23182 (63.43%) and female literates were 13364 (36.57%).

According to 2011 Census, total population of workers in the study area was 25079 (39.70%). Main and marginal workers were 22400 and 2679 respectively, which is 35.46% and 4.24% of the total population. Total non-working population was 38092 (60.30%**).** Main workers are classified in four categories as cultivators, agricultural workers, household industry workers and other workers. As per 2011 Census, Out of total 22400 main workers in the study area, there were total 6047 cultivators (27%), 3019 agricultural workers (13.48%), 178 household industry workers (0.79%) and other workers 13156 (58.73%).

The infrastructure resources base of the study area with reference to education, medical facility, water supply, post and telegraph, transportation, communication facility, power supply and existence of nearest town etc. according to the Village Directory Census CD 2011 was analyzed. The above statistics are based on 2011 Census records. Present situation in the region is much better in terms of all the facilities required for the people of the region.

Socio-economic survey was conducted during July 2-5, 2018. The villages were selected randomly, four each from Lalpur tehsil (Zankhar, Mithoi, Rasangpar & Modpar) and Khambhalia tehsil (Nana Mandha, Vadinar, Bharana & Khajurda village).

On the basis of interpretation made above, primary survey (interaction with stakeholders, FGD, community consultation and discussion with influential persons of the study area) and secondary sources, sanitation and drainage system is found to be very poor in the study area. Approx. 80% area has no drainage system in the study area.

Livelihood of most of the people of the study area depends on jobs, fishing, fishing allied, Agriculture, and cattle rearing. Tap water and Hand pump are the source of

drinking water in the study area. No chronic or epidemic disease has been reported in the study area except general cases of cough and fever.

Interaction with different village Sarpanch/Society Heads/ villagers was done to understand the socio-economic issues of the region and their needs, as summarized in **Table 3.1**.

Table 3.1: Details of Interaction with Different Groups in the Study Area

Sr. No.	Village Name	Key Contact Person	No. of Persons Present	Major Concerns/ Problems/ Focus Areas for CSR Activities
A.	**Lalpur Tehsil**			
1.	Zankhar	Mr. Khuman Singh	8	Education, Communication, Employment, Power, Drinking Water (Muddy), Quality & Agriculture Irrigation Problem, Health Care Facility, Health Problem (Cough & Skin), Pollution (Air, Water, Noise & Land) etc.
2.	Mithoi	Mr. Abhay Singh	10	Employment, Health (Skin), Drinking Water (Scarcity), Pollution (Air)
3.	Rasanpar	Mrs. Modiben Desukhbhai	22	Health (Skin & Cough), Sanitation, Irrigation, Drinking Water, Employment, Street-Light etc.
4.	Modpur	Mr. Lakhubhai	8	Health, Drinking Water, Education, Employment etc.
B.	**Khambhalia/Vadinar Tehsil**			
5.	Nana Mandha	Mr.Sagar Ameen	21	Load-Shedding, Employment, Health (Cough & Skin), Pollution (Air, Water, Noise & Land) etc.
6.	Vadinar	Mr. Kaleem Abdul	15	Education, Health, Transportation, Water (Color and Taste), Employment, Migration in Gulf Countries etc.
7.	Bharana	Mr. Mahaveer Singh	14	Drinking Water (Oily), Health (Dengue, Malaria & Skin), Transportation, load-shedding 2-3 hours/day etc.
8.	Khajurda	Mrs. Habeebbhai Ramabhai	15	Higher Education, Employment, Load Shedding 3-4 hours, Water, Health, Migration, Pollution (Air, Water & Land) etc.

The average QoL (Quality of Life) index value for the study area is satisfactory due to facilities like, educational facilities, roads, also availability of basic needs viz., food, clothing & housing. Medical and communication facilities were not adequate in the

study area; Improvement in these fields will help to increase quality of life of the people in the study area.

CSR Initiatives by Nayara Energy Limited

Nayara Energy Limited is an independent oil company with strong presence across the hydrocarbon value chain from refining to retail. The Company has 20 MMTPA refinery situated at Vadinar, District Devbhumi Dwarka in Gujarat, India. The refinery is supported by captive port, storage facilities and a thermal power plant.

At Nayara Energy, Corporate Social Responsibility (CSR) has been an integral part of its business strategy. Nayara Energy appreciates the social and economic diversity in the Country and has consciously embedded the community engagement dimension in its business planning, risk and reputation management processes. The CSR initiatives of Nayara Energy have played a pivotal role in improving the quality of life of the communities living in the vicinity of operations of the Company.

Nayara Energy Ltd. runs the CSR activities majorly in following key areas and so far has touched the lives of about 5.8 lakh people during 2014-18.

A. Health and Sanitation: Different CSR initiatives have been undertaken by Nayara Energy as:

- Community Health Project
- Nutrition Support to TB patients in Devbhumi Dwarka
- Study of Health Scenario at Devbhumi Dwarka
- Solid Waste Management Project

B. Education

- Indradhanush- Shiksha ke saat rang
- Skilling teachers in Activity based learning
- Promoting Secondary Education through Scholarship
- Gramshiksha (Village Education)
- Bharat Ek Khoj 2018
- Navtar – A Centre for Educational Innovation

C. Initiatives in Livelihood Development

- Veterinary Mobile Clinic
- Agriculture Development & Animal Husbandry
- Integrated Lab for soft-skills development (Ilabss)
- Stitching Centre in Vadinar

D. Sports Promotion

E. Women Empowerment

- Aanchal
- Care for Elderly

F. Infrastructure Development

- Nayara Energy is also contributing to the Abhiyaan with construction, repair, and refurbishment of school and residential toilets across the villages. To ensure regular use and upkeep of the new facilities, Nayara Energy collaborated with NGO, Anarde Foundation to conduct customized awareness generation activities using Behaviour Change Communication (BCC) tools. Various infrastructure development projects were also carried out by the company to improve the village infrastructure which include Construction of Community centres, Construction of Gaushalas and other repair and refurbishment work.

G. Environmental Sustainability

- Water Resource Development and Management Program
- Waste Paper recycling project
- Leadership Development Program with Acumen India

4.0 Prediction of Impacts and Mitigation Measures

Identification of impacts leads to quantification and evaluation of impacts and accordingly suggestion on appropriate mitigation measures. Although, in general, number of impacts have been identified while describing existing environmental status, it is necessary at this stage to identify the critical impacts that are likely to occur due to the proposed ADP-1 Project activities for various components of the environment.

Summary of environmental impacts and mitigation measures during construction and operational phase of the proposed project are presented in **Tables 4.1** and **4.2** respectively.

Table 4.1: Summary of Anticipated Adverse Environmental Impacts and Mitigation Measures during Construction Phase

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Loose soil at construction site	During monsoon season run off from construction site will be routed to a temporary sedimentation tank for settlement of suspended solids.	_
Air Quality	Increase in dust and NO_2 concentration	Leveling activity and heavy vehicular movement	Sprinkling of water in the construction area and on unpaved roads. Proper maintenance of vehicles will be done.	The impact will be low, as the main approach road will be tarred.
Noise	Increase in noise level	Construction equipment	Equipment will be kept in good condition to keep the noise level within the norms 90 dB(A).	Workers will be provided necessary protective equipment *e.g.* ear plug, earmuffs.
Terrestrial Ecology	Clearing of vegetation	Soil enabling activities	Landscaping and extensive plantation will be done.	-
Socio-economic	--	--	--	No land acquisition. No R&R issues involved.

Table 4.2: Summary of Anticipated Adverse Environmental Impacts and Mitigation Measures during Operational Phase

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
Wastewater	Deterioration of surface water quality	Discharge from various plant units	Wastewater shall be treated in the existing WWTF.	The entire effluent will be reused within the refinery
Air Quality	Increase in PM, SO_2 and NOx levels in ambient air	Vehicular emissions No stack emissions	Strict adherence to I&M of vehicles, Valid PUC	Requirement of truck movement is very less, hence no significant impact envisaged.
Solid waste	Groundwater contami-nation	Leachate from storage facilities	Properly lined storage of leachable material	Strict adoption of S&HWM Rules, 2016
Ecology				
a. Terrestrial	Impact on plant species	Nil	Nil	--
b. Aquatic	Impact on water bodies	Treated waste water from plant	The wastewater will treated in WWTF and and treated wastewater will be used for horticulture and dust suppression	As entire treated effluents will conform to prescribed limits, shall be reused within the refinery, no significant impact on aquatic life is expected.
Noise	Increase in noise levels in the plant area.	Equipment in main plant and auxiliaries.	Selected equipment will conform to noise levels prescribed by regulatory agencies. Provision of green belt and plantation would further help in attenuating noise.	Employees working in high noise areas would be provided earplugs/ earmuffs as protective device.
Demo-graphy and Socio-Economic	Strain on existing amenities like housing,	Influx of people for proposed refinery	Local population will be given preference in awarding work. No	Overall socio-economic status of the area is expected to improve

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
	water sources and sanitation, medical and infrastructure facilities.	employees as well as contractor's employees/ labourers.	significant impact is envisaged. Additional facilities will be developed by the project proponents.	considerably.

Budgetary Allocation for Environmental Protection

Environment protection measured will be monitored and executed by the environmental management cell/department of the Nayara Energy. It is proposed to invest Rs. 10 Crores on pollution control and treatment. In addition, Rs. 0.14 Crores per annum will be spent as recurring cost. The budgetary allocation for Environment Protection is given in **Table 4.3**.

Table 4.3: Budgetary Provision for Environmental Protection Measures

Sr. No.	Description of Item	Cost (Rs. in Crores)	Recurring Cost/year (Rs. in crores)
1	Air pollution control systems (Thermal Oxidiser)	7.5	0.1
2	Pre Treatment Unit in PP	2.5	0.04
	Total	10	0.14

5.0 Analysis of Alternatives (Site & Technology)

The proposed ADP-1 Project shall take place within the existing refinery complex of M/s Nayara Energy ltd., and no additional land shall be acquired.

Various units are used to process crude oil to make desired products in the refinery. Latest and best available refinery technologies that shall ensure maximum conversion efficiency, production of superior grade clean products and minimum losses shall be selected for the ADP-1 Project involving polypropylene plant of 450 KTPA capacity. The company is in regular touch with all leading Technology companies of the world to get the latest updates on the various existing and also evolving technologies.

6.0 Environment Monitoring Programme

Monitoring of environmental components during operation phase is a vital part of the environmental mitigation measures. Only frequent monitoring can assess the functioning and efficacy of all pollution control equipment. Thus the project proponent has to establish a separate full-fledged environmental laboratory (or use NABL accredited laboratory) to monitor various environmental quality parameters of air, water, soil, noise level in the plant as well as in the surrounding impact zone. For this purpose, post project monitoring plan is suggested, which the project proponent shall follow.

Monitoring activity is mainly envisaged covering the following aspects:

- Air Quality (stack emissions & ambient air including fugitive emissions)
- Water and Effluent Quality
- Soil Quality
- Ecology
- Noise Levels
- Green Belt Development
- Social Welfare Activities Undertaken

The environmental quality-monitoring program will be carried out in the impact zone with suitable sampling stations and frequency for environmental parameters with respect to different environmental components.

Details of existing environmental monitoring programme including number of sampling locations, parameters to be monitored, frequency of monitoring done by Nayara Energy Limited for the existing 20 MMTPA refinery and further additional requirement for environmental monitoring for the proposed ADP-1 Project are suggested. Offline monitoring for various parameters is carried out through NABL accredited laboratory, whereas online monitoring is done by in-house facility.

Refinery has well-established Environment Management Cell for ensuring compliance with all the Environment Clearance conditions. The Environment Management Cell is headed by senior executive and reports directly to the Director & Head of Refinery. The company has a full-fledged safety department to look after the safety issues of the plant. The same shall be take care of the proposed ADP-1 Project also.

As required, the status of environmental clearance stipulation implementation will be submitted to regulatory authorities in soft copy by 1st December for the period from April to September and by 1st June for the period from October to March of every year. These reports will be put up on company's website as per their procedure and will be updated every six months. The conventional pollutants will be monitored on monthly basis and reports will be submitted to SPCB, as per the requirements.

7.0 Additional Studies

M/s Nayara Energy Limited is proposing setting up ADP-1 Project, which involves production of 450 KTPA polypropylene using existing refinery feedstock. Risk assessment analysis and public consultation aspect are covered here.

Risk Assessment Analysis: Risk assessment has been carried out for the proposed ADP-1 project with the objectives of analyzing consequences in case of accidental release of hazardous chemicals. The hazards associated with the various units have been identified by the computation of Fire, Explosion and Toxicity Indices (FETI). The units have been categorized based on the FETI into Low, Medium, Heavy and Severe hazards categories. Risk is quantified in terms of probability of occurrence of hazardous events and magnitude of its consequences. Maximum Credible Accident (MCA) analysis has been carried out at 2F, 3D and 5D atmospheric conditions for partial and full rupture of process equipments where 2, 3 and 5 are wind velocities in m/s and F and D are atmospheric stability classes. The effective distances have been tabulated for heat radiation levels of 37.5, 12.5 and 4 KW/m^2 for fire scenarios and overpressure levels of 0.01, 0.1 and 0.3 bar for explosion scenarios. The effective distances for toxic release scenarios have been computed for Immediate Dangerous Life and Health (IDLH) concentration.

The study has used individual risk and societal risk as the main risk measures, as these are currently regarded by both industry and the regulators as being required for decision making. This type of analysis is used as a basis for onsite decisions and its use could be extended to offsite decisions. The individual and societal risk measures are based on the in-plant and surrounding population, its density and probable ignition sources. The Individual Risk (IR) level is the calculated annual risk loading to a specific individual or group of individuals. Individual risk is typically depicted as contour plots on overall plot plan of a facility, the risk level falling off rapidly as one moves away from the source of the leak / epicentre of potential explosions.

Societal risk is depicted on a cumulative graph called an F/N curve. The horizontal axis is the number of potential fatalities, N. The vertical axis is the frequency per year (F) that N or more potential fatalities could occur. This risk indicator is used as a measure for the social disruption in case of large accidents. Various risk acceptance criteria split the graph into acceptable, as Low as Reasonably Practicable (ALARP) and Unacceptable regions so that different actions have can be taken depending on where the F/N curve falls.

From the study, it can be concluded that maximum individual process risk generated due to accidental leakage from any equipment or storages is in the range of 10^{-4} level falling within the plant boundary limits. As per HSE UK guidelines, this risk level falls in ALARP region and which can be controlled by implementing mitigation measures. The special as well as general mitigative measures for process equipment and storages have been recommended. The societal risk, which is demonstrated by F/N curve, for all process equipment and storages is in acceptable region. Facilities to be provided at the control room to tackle emergency scenarios have been described.

Mitigative measures for natural disasters viz. earthquake, flood, cyclones and severe storms have been recommended. Personal protective equipment according to types of hazards has been tabulated. Oil spill response plan have also been outlined.

Disaster Management Plan (DMP) has been prepared to give an approach to detail organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies. Types and causes of disasters have been included in addition to different phases of the disaster to tackle any unforeseen event effectively. Roles and responsibilities of various key personnel have been described. The plan also includes response planning procedures to cover onsite and offsite emergencies.

Public Consultation:

Humble request to consider the present modernization proposal of ADP-1 **under para 7(ii) (a) of EIA notification 2006, amended on dated 23.11.2016.**

Justification: M/s Nayara Energy has applied for environmental clearance for expansion of Refinery from 20 MMTPA to 46 MMTPA along with 10.75 MMTPA Petrochemical Complex, EC for which is under consideration at MoEF&CC. The present proposal “Asset Development Project-1 (ADP-1)” is a small part of the total Refinery Capacity Expansion Project, and involves production of 450 KTPA Polypropylene (PP) by revamping FCC Unit and unsaturated LPG treating unit of the existing refinery. The revamping of FCCU will bring some changes in the product slate of the existing refinery, however the total crude throughput shall remain same (20 MMTPA).

Thus, the proposed ADP-1 project is a modernization project with change of product mix in existing units, while the overall throughput remains same, exemption of Public hearing under para 7(ii) (a) of EIA notification 2006, amended on dated 23.11.2016 is requested. The project does not envisage any significant load on the environment, as there is no furnace in these units (hence no air pollution) and effluent generated will be treated in existing units, and there is no major Hazardous waste load due to this modernization project. Therefore, humble request to exempt Public Hearing and grant environmental clearance.

8.0 Project Benefits

Besides the tangible benefits (production of petroleum product and employment generation), the project has intangible benefits like use of latest world class technologies for manufacture of polypropylene resulting into maximum recovery of product and minimum emissions/wastes, minimal/acceptable impact on environment, socio economic benefits to the local people.

9.0 Environmental Cost Benefits

The proposed ADP-1 Project will result in improvement of infrastructure as well as upliftment of social structure in the area to some extent. The people residing in the nearby areas will be benefited indirectly. There would be more opportunities for employment generation to the locals especially the youths. About 3300 workers are estimated to be employed during construction phase of about 2 years (upto 7000 during peak construction period) and about 150 persons will get employment during the operation phase.

The company also proposes to provide training to local youths, so that their skills can be gainfully utilized in project activities. The project will create opportunities for direct employment. The project will also create opportunities for indirect employment due to increase in trades viz. stockist / retailers of building material, groceries, provision shops, medical stores, garment shops, furniture shops, hotel & restaurants, etc. in the region to meet the increased requirements.

CSR Initiatives of Nayara Energy Limited

At Nayara Energy, Corporate Social Responsibility (CSR) has been an integral part of its business strategy. Nayara Energy appreciates the social and economic diversity in the Country and has consciously embedded the community engagement dimension in its business planning, risk and reputation management processes. The CSR initiatives of Nayara Energy have played a pivotal role in improving the quality of life of the communities living in the vicinity of operations of the Company.

Nayara Energy's vision is to be among the most respected organizations in India by doing what is right and rightful for the communities and nation at large. Nayara Energy aspires to build a symbiotic relationship with its stakeholders and intends to make them equal partners in the process of nation building. It firmly believes that their role is to lay the path that is collaborative, progressive, inclusive and sustainable through various CSR programs. It also believes that technology and innovations can hasten the process of change and endeavour to support new and innovative models of development.

Nayara Energy Ltd. runs the CSR activities majorly in following key areas:

- Health and Sanitation
- Education
- Livelihood Development
- Sports Promotion
- Women Empowerment
- Infrastructure Development
- Environmental Sustainability

CER Budget

Besides the CSR activities under the existing refinery protocol, additional CER (Corporate Environmental Responsibility) fund to the tune of Rs. 19.5 Crores (as per MoEF Notification dated May 1, 2018) has been allocated in this proposed ADP-1 Project. CSR as well as activities shall be planned in participatory mode involving the local residents for the activity identification and at the planning stage.

Green Belt Development

Nayara Energy has already developed a large green-belt along the periphery of the refinery. Some plantation will be done along the boundary of ADP-1 Project as appropriate. However, additional green belt is not proposed in this project. However Greenbelt in and around the refinery will be strengthened/maintained.

10.0 Environment Management Plan

Environmental Management Plan (EMP) provides an essential link between predicted impacts and mitigation measures during implementation and operational activities. EMP outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or mitigate adverse environmental impacts, and the actions needed to implement these measures.

The likely impacts on various components of environment due to the project during developmental activities have been identified and measures for their mitigation are suggested for the proposed ADP-1 Project.

The EMP comprises a series of components covering direct mitigation and environmental monitoring, an outline of waste management plan and a project site restoration plan. Therefore, environmental management plan has been prepared for each of the above developmental activities.

Since the proposed developmental activity is a very small activity in comparison to the existing refinery, and does not involve air emissions, limited wastewater generation to be treated in existing wastewater treatment plant, the existing pollution control facilities available for the existing refinery shall be adequate to cater the need of ADP-1 also.

Budgetary Allocation for Environmental Protection and CER & CSR Activities

During production of specific grade of polypropylene, some VOC emissions are expected, for which control system comprising of thermal oxidiser shall be installed. An amount of Rs. 10.0 Crore has been allocated towards the same with a running cost of Rs. 0.14 Crore annually. Besides, adequate financial provision for environment protection measures shall be made, if required.

Tentative CER Schemes

Tentative projects to be undertaken under Corporate Environment Responsibility (CER) and likely expenditure involved (Rs. 19.5 Crore) is summarized in **Table 10.1**.

Besides, total CSR budget projection for the existing Refinery Business for next 5 years is about Rs. 74.58 Crores (**Table 10.2**).

Table 10.1: Tentative Projects to be Undertaken Under Corporate Environment Responsibility and Likely Expenditure Involved

Projects	Objective	Per Unit Cost (Rs. in Lakhs)	Total Unit Proposed (Nos.)	Proposed Budget for ADI-1 (Rs. in Lakhs)	Proposed Outcomes to be Achieved
Construction of Big Water harvesting structures	To conserve rain water and improve the quality of ground water	50	8	400	Around 700 Ha of additional land will be brought under Irrigation and 2.6 MCM of additional water storage capacity will be created
Developing a multi-speciality sports complex	To develop a good sport infrastructure	550	1	550	Youth from entire Dwarka will have access to better/affordable training facilities

Start-up fund for development of Micro Enterprises	To identify innovative business ideas suitable to local needs and to provide support for development of Micro Enterprises)	100	10	1000	Integrated Employment, Micro Entreprise and Entrepreneurship Development Program leading to employment generation to hundreds of people which will multiplier the local business growth potential in the region (The program will possibly be designed with UNDP)
Total				**1950 (Rs. 19.50 Crores)**	

Table 10.2: Proposed CSR Budget under CSR Activities for the Existing Refinery

Sr. No.	Focus Area	Annual Budget under CSR (Rs. in Crore)				
		2019-20	2020-21	2021-22	2022-23	2023-24
1.	Health & Sanitation	5.70	5.40	5.60	3.30	3.40
2.	Education & Skill Development	3.03	2.6	0.25	0.25	0.25
3.	Water & Livelihoods	3.3	6	8	10	10
4.	Rural Infrastructure Development	1.5	1.5	1.5	1.5	1.5
	Total	13.53	15.5	15.35	15.05	15.15

**Please note that the above-mentioned figures are just the projections, these number might change based on the final profit figures in coming years.*

It is to further affirm that the environmental management practices being followed in the existing refinery shall be adopted/extended for the ADP-1 Project also with suitable augmentation/creation of new facilities, as required to ensure that all the environmental quality parameters within the refinery premises and in the region remain within the permissible levels. Efforts will further be made to ensure adequate social welfare activities in region, resulting in overall development of the region with improved quality of life of the people in the region.

11. Summary and Conclusion

In summary, the proposed site for setting up ADP-1 Project in the existing refinery premises was granted environmental clearance earlier in 2008 by MoEF&CC for 60 MMTPA capacity. The project site is slightly undulated with scrub vegetation, barren land and some agriculture land. Therefore, it will not involve loss of vegetation, and biodiversity will not be affected as the vegetation is similar in the whole area with no sensitive ecosystem or rare and endangered flora or fauna, and hence no environmental loss will be there in terms of net productivity value.

The proposed modernization project will have negligible/ certain level of marginal impacts on the local environment. However, with the implementation of the proposed pollution control measures and environment management plans, even the minor impacts anticipated due to construction and operation of the proposed expansion project will be mitigated.

Further, development of this project will have certain beneficial impacts/effects in terms of bridging the demand and supply gap for polypropylene. This will also provide employment opportunities during construction as well as during operational phase of the project, and further social upliftment of the region through CER and continuous CSR initiatives by the Nayara Energy Ltd.

Thus, in view of considerable benefits from the project without any significant adverse environmental impacts due to effective implementation of EMP, the proposed project would be beneficial to the region as well as to the nation.

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Chapter 1

Introduction

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Introduction

1.1 Background

M/s Nayara Energy Ltd., erstwhile Essar Oil Ltd., is operating a 20 MMTPA refinery complex at Vadinar, Devbhumi Dwarka, Gujarat. It is the second largest single location Refinery in India and is also among the top 5 most complex refineries in the world. The company continues to strive for excellence with its strengths, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability.

In addition, it has a strong retail network of about 4,900 fuel stations catering to different parts of the country. The network is being further expanded with about 2600 more retail stations in near future.

Further, M/s Nayara Energy has earlier applied for environmental clearance for expansion of Refinery from 20 MMTPA to 46 MMTPA along with 10.75 MMTPA Petrochemical Complex vide online proposal no. IA/GJ/IND2/119511/2018 Dtd 2nd June 2018. ToR was issued on 3rd Aug 2018, and EIA/EMP studies were conducted accordingly. Final Report was submitted to the MoEF&CC on October 15, 2019 and the project was appraised in 17th EAC meeting held on Feb 26, 2020, wherein the committee advised to conduct public hearing at the project site. Subsequently, M/s Nayara Energy approached GPCB for the same, and public hearing was scheduled for May 1, 2020. But, due to COVID 19 pandemic all across the world, the public hearing has been called off till the normalcy is attained in the Country and State also.

In light of above, Nayara Energy, in its immediate business plan towards expansion into petrochemicals, desires to set up a 450 KTPA Polypropylene plant, which will produce 450 KTPA Polypropylene, a new product for Nayara Energy. This will be achieved by suitably modifying/revamping existing FCC Unit and existing Unsat LPG Treating Unit and addition of Propylene Recovery Unit (PRU) and Polypropylene Unit. This project has been named as **"*Asset Development Project-1 (ADP-1) of Nayara Energy*".**

Proposed ADP-1 shall take place at the land available within the existing refinery premises. Location of existing and proposed project is shown in **Fig.1.1.1.**

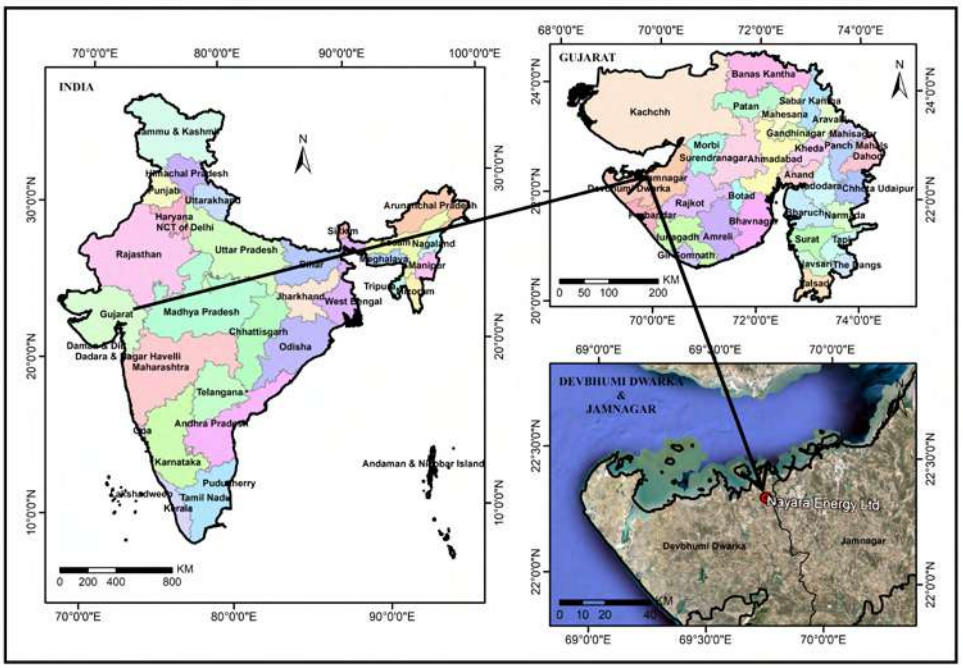

Fig. 1.1.1: Location of Existing Refinery and Proposed ADP-1 of M/s Nayara Energy Ltd.

As per the Environmental Impact Assessment (EIA) Notification dated 14th September 2006 read with amendments, the proposed ADP-1 project (setting up of Polypropylene Plant) falls under Category A with project or activity type '4a' "Petroleum Refining Processes" and '5(c)' "Petrochemical complexes, which requires prior EIA for Environmental Clearance (EC) from the Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

M/s Nayara Energy Limited has obtained the Standard Terms of Reference (ToR) from MoEF&CC for EIA of the proposed ADP-1 Project for Setting up of 450 KTPA Polypropylene Plant at the site, located within existing refinery premises. M/s Nayara Energy Limited, the project proponent is required to prepare EIA/EMP report based on one season environmental quality data as per the Standard ToR issued by the MoEF&CC. Hence, M/s Nayara Energy Limited approached CSIR-NEERI to conduct EIA study for the purpose.

It is pertinent to mention here that the present proposal number IA/GJ/IND2/ 149284/2020 for the Project "Asset Development Project-1 (ADP-1)" is a small part of the total Project for which earlier EC was applied for. In the earlier proposal, Propylene/Polypropylene production of 2050 KTPA (1000+1050 KTPA) was planned, whereas in this project, it is 450 KTPA only. Since, this project is a part of the total Refinery Expansion Project (EIA Report already submitted to MoEF&CC in October

2019), the baseline data collected for the Project during Summer 2018 has been used along with other relevent components as applicable.

The present EIA report addresses the environmental impacts of the proposed ADP-1 project, and proposes the mitigation measures for the anticipated impacts. The EIA report is prepared based on the standard ToRs issued by MoEF&CC, vide letter no. J-11011/86/2020-IA-II(I), dated April 18, 2020.

In line with the conditions of standard ToR granted by MoEF&CC, the present EIA report has been preparedfor the purpose of environmental clearance by MoEF&CC. This is a small modernization project, where there is no change in crude throughput and there is no significant load on the environment and no furnace proposed in these 2 units, effluent generated will be treated in existing unit. Thus, Environment Clearance may be granted by exempting Public Hearing as per Para No. 7 (ii) (a) of the EIA Notification, 2006 & Amendment Notification dated Nov. 23, 2016.A copy of the standard ToR letter, along with compliance status is enclosed as **Annexure 1**. Various statutory clearances obtained so far in the context of existing and proposed project are given in **Annexure 2**.

1.2 Justification of Proposed Project

1.2.1 Need for the Project (demand/supply gap) and its importance

Strategic Rational For Phase 1 (ADP-1) Project of Nayara Energy

Program for ADP-1 project proposed to be undertaken by Nayara is based on the following main strategic considerations:

- **Product Diversification:** With volatility on crude and key fuel products, diversification to petrochemicals is becoming a necessity for pure refiners like Nayara Energy.
- **Growing Indian Demand:** Indian petrochemical demand, especially for polymers is growing more rapidly than the rest of the world (Indian Polypropylene demand is estimated to grow at 8-9% CAGR). India have projected deficit of 1.2 million tonnes by 2022 as demand growth is outpacing capacity expansions. Proposed project is expected to get ready market in India in view of emerging deficit.
- **Cost Competitiveness:** Propylene is the basic petrochemical building block most suited for refinery; cheapest source for C3= is from FCC, and Nayara already has a large FCC which can be revamped for high severity to maximize C3= production and support a world scale PP unit.
- **Refinery Integration:** Nayara's refinery, leveraging its high complexity to process the cheapest and dirtiest crudes, can make the feedstock available for petrochemical production at very competitive costs; the cheap power and steam cost can help keeping the conversion cost for petrochemicals at relatively low levels.

- **Government Support:** Indian Government is promoting 'Make in India' to reduce dependency on imports

1.2.2 India PP Market Opportunity

- Petrochemicals play a vital role in the functioning of virtually all key sectors of economy which includes agriculture, infrastructure, healthcare, textiles and consumer durables. Polymers provide critical inputs which enable other sector to grow. Petrochemical products cover the entire spectrum of daily use items ranging from clothing, housing, construction, furniture, automobiles, household items, toys, agriculture, horticulture, irrigation, and packaging to medical appliances.
- India's strong economic growth will drive a phase of rapid demand growth in downstream plastics processing, with PP demand forecast of 8-9% for next 10 years as per market reports of various global petrochemical consultants. Rapid urbanisation, young demography and growing income supporting strong PP demand growth in India.
- There is significant upside potential for per capita PP consumption in India. Current consumption is only 3.8 kg per annum, compared with the global average of 9.4 kg and 20 kg observed in developed economies such as the US.
- Average annual incremental PP demand in India expected to be 540 KTPA during period of 2018 to 2022 which necessitates world scale capacity addition every year.
- High population, relatively low per capita consumption and expected high economic growth should propel India's polymer consumption to new levels in future. Historically demand of PP has grown at 1.5 times of GDP growth in India and it is expected to grow at minimum 8% per year in future. Current PP demand of 5.5 MMTPA (year 2019-20 estimate) is expected to reach 8.8 MMTPA by year 2025-26 with this 8% growth rate. This demand growth likely to create need of 3.0 MMTPA PP capacity addition in India by 2025.

Projected demand for polypropylene (PP), production capacity and capacity addition requirement in the country is shown in **Table 1.2.1**, and demand-supply scenario for polypropylene in India upto 2030 is depicted in **Fig. 1.2.1.**

Due to lag of capacity addition as compared to demand addition, India is expected to have deficit of 1.2 million tonnes by 2022. India will continue to have strong deficit beyond 2022 as well even if all speculative and uncertain capacity additions plans starts production.

Table 1.2.1: Projected Demand, Present Capacity and Additional Capacity Requirement for Polypropylene in India upto 2025-26

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
PP Demand	5.5	6.0	6.5	7.0	7.6	8.2	8.8
Present PP Capacity	5.8	-	-	-	-	-	-
Capacity addition required	-	0.2	0.7	1.2	1.8	2.4	**3.0**

All values are in MMTPA.

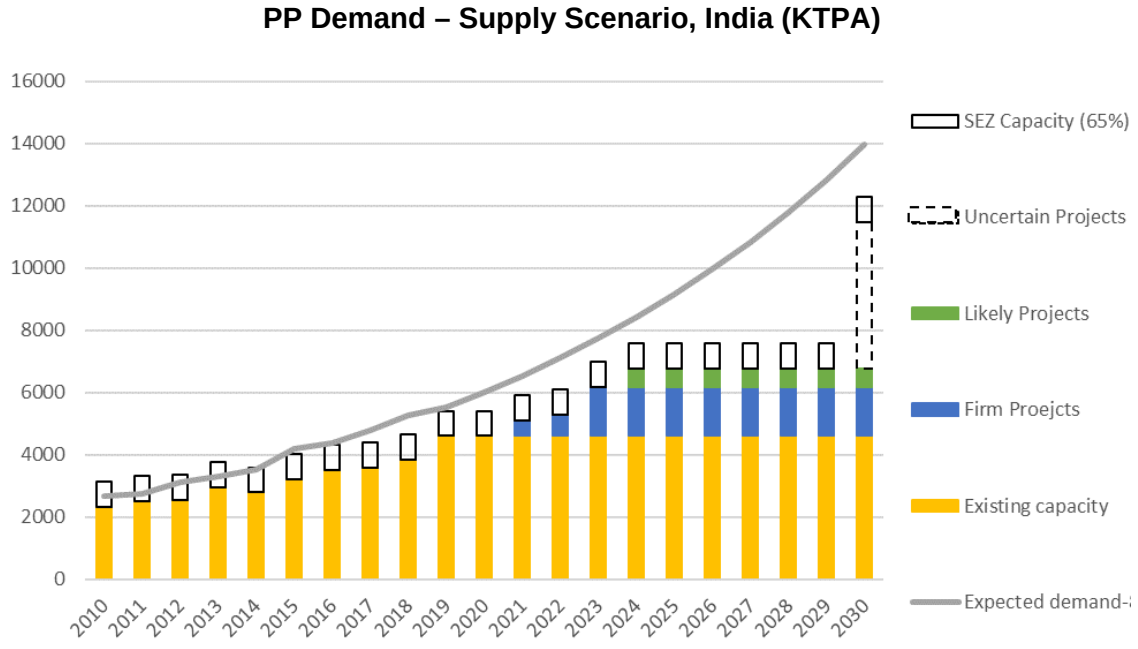

Fig. 1.2.1: Demand – Supply Scenario for Polypropylene in India upto 2030

Employment Generation due to the Project

The proposed ADP-1 project will provide direct/indirect employment to approx. 7000 persons during the peak construction phase and about 150 persons during operation.

1.3 EIA Study for the Proposed ADP-1 Project

1.3.1 Objectives of the Study

The main objective of the present study is to conduct Environmental Impact Assessment incorporating baseline environmental quality data of one season leading to identification, prediction and evaluation of impacts and suggest mitigation measures and environmental management plans for the proposed ADP-1 project of Nayara Energy Refinery as per approved Standard ToR.

1.3.2 Scope of the Study

With a view to assess the environmental impacts arising due to the proposed expansion/modernization of existing refinery with respect to ADP-1 project, M/s Nayara Energy Limited approached CSIR-NEERI to prepare the EIA report and suggest an Environment Management Plan (EMP) for mitigating adverse impacts from the proposed project.

Environmental baseline monitoring carried out during Summer 2018 for the Refinery Capacity Expansion Project with Petrochemical Complex has been used. Various modelling exercises have been carried out to predict and evaluate the impacts due to the proposed project. The scope of the present study is in line with the ToR as issued by the MoEF&CC.

The scope of the study broadly includes:

- To predict incremental levels of pollutants in the terrestrial study area due to the proposed plant activities;
- To evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies;
- To prepare an EMP outlining the measures for improving the environmental quality and scope for future expansions for environmentally sustainable development; and
- To identify critical environmental attributes required to be monitored suggesting a post-project monitoring programme.

1.3.3 Methodology of the Study

Reconnaissance was conducted by the NEERI team along with the concerned officials from the project proponent. Sampling locations were identified by considering the following aspects:

- Predominant wind directions based on the metrological data generated at meteorological station at the existing refinery of Nayara Energy Limited;

- Existing topography, drainage pattern and location of surface water bodies like ponds, rivers and sea;
- Location of villages/towns/sensitive areas;
- Areas which represent baseline conditions; and
- Collection and analysis of baseline data for various environmental attributes.

The field observations are used to:

- Identify extent of negative impacts on community/natural resources; and
- Identify mitigation measures and monitoring requirements.

The study also provides framework and institutional strengthening for implementation of the mitigation measures.

1.3.4 Study Area Details

The study area for the present EIA study is the area covered within the 10 km radius from the centre of refinery premises. The study area map showing 10 km radius is shown in **Fig. 1.3.1**.

Fig. 1.3.1: Study Area Map with 10 Km Radius with Nearby Villages

The refinery is located about 39 km from Jamnagar on SH-25, on the way to Dwarka in Gujarat State on West Coast of India. It is about 8-10 km from the sea front with central coordinate of refinery as; latitude 22°19'49.18" N and longitude 69°44'58.07" E. The site is situated at Vadinar village, Khambhalia Tehsil, Devbhumi Dwarka district, Gujarat. Nearest railway station is Jamkhambhalia, which is about 20 km and nearest airport is Jamnagar, which is about 30 km from the site.

As per 2011 Census, total population of the study area was 63171, out of which male population was 34694 (54.92%) and female population was 28477 (45.08%). Total geographical land area of the study area is 290.48 km^2 with population density of 217 persons/km^2. Total child population (below 6 years of age) was 8779 (13.90%). Sex ratio (number of females/1000 males) of the total population was 821. Overall literate population was 36546 (57.85%) and illiterate population was 26625 (42.15%).

1.3.5 Structure of the EIA Report

EIA study has been conducted as per the approved standard ToR and presented in the following Chapters.

Executive Summary

Chapter 1: Introduction

Chapter 2: Project Description

Chapter 3: Description of the Environment

Chapter 4: Anticipated Environmental Impacts & Mitigation Measures

Chapter 5: Analysis of Alternatives (Technology and Sites)

Chapter 6: Environmental Monitoring Programme

Chapter 7: Additional Studies

Chapter 8: Project Benefits

Chapter 9: Environmental Cost Benefit

Chapter 10: Environmental Management Plan

Chapter 11: Summary and Conclusions

Chapter 12: Disclosure of Consultant Engaged

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Chapter 2

Project Description

Chapter 2

Project Description

2.1 Introduction

Nayara Energy Ltd, erstwhile Essar Oil Ltd, is a strong name worldwide in Oil & Gas Sector having its registered office at Khambalia Post, PO Box 24, District- Devbhumi Dwarka, Gujarat-361305. Its 20 MMTPA Vadinar Refinery is second largest single location Refinery in India and is also among the top 5 most complex refineries in the world. The company continues to strive for excellence with its strengths, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability.

Nayara Energy is operating a 20 MMTPA refinery complex at Vadinar, Devbhumi Dwarka, Gujarat. In addition it has a strong retail network/retail station catering to different part of the Country. The network is being expanded further.

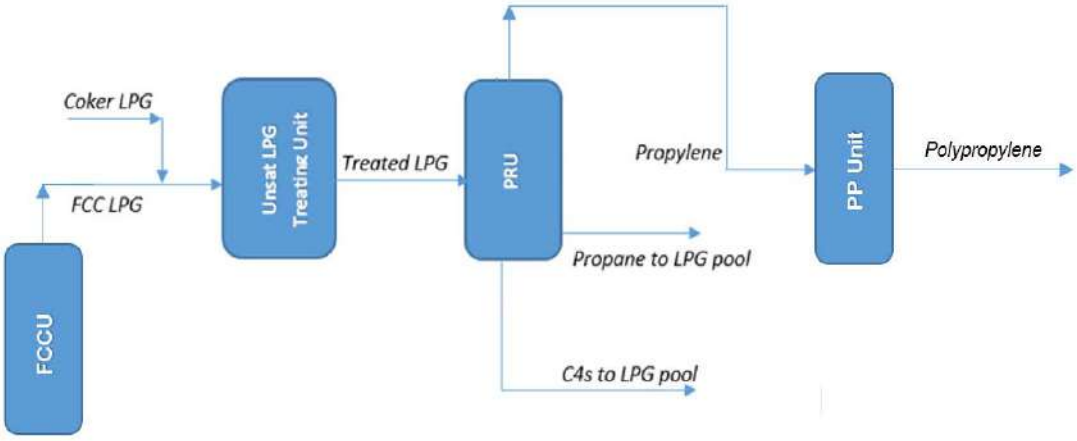
Nayara Energy, in its immediate business plan towards expansion into petrochemicals, endeavours to set up 450 KTPA (kilo tonne per annum) Polypropylene plant.

The chapter highlights features of the existing 20 MMTPA petroleum refinery, proposed ADP-1 project along with their location and layout. Details of various processes, process units, products, production capacities, required infrastructural facilities, utilities and services are given along with various sources of waste generation (air emissions, liquid effluent and solid & hazardous wastes) with their quantity and pollution control measures.

2.1.1 Salient Features of the Project

Nayara Energy endeavours to set up 450 KTPA (kilo tonne per annum) Polypropylene plant. The primary source of feedstock is its existing FCC Unit, which will be revamped to boost its performance to produce high propylene in FCC LPG stream. As a part of revamp there will be modifications in Reactor internals and columns internals, addition of few exchangers and pumps etc. to existing units. This LPG, after mixing with DCU LPG, will go to existing Unsat LPG Treating Unit which is also to be revamped. The treated LPG, post caustic treatment, will be routed to a new Propylene Recovery Unit (PRU) to recover Propylene, which subsequently will be sent to the new Polypropylene Plant to produce polypropylene which is a new product for Nayara. The existing “Environment Clearance” has expired in Sep’18 and hence this PFR is made for the purpose of new “Environment Clearance” for the above mentioned project. This project is named as Asset Development Project-1 (ADP-1).

A representative Schematic of proposed unit is given below:



The salient features of the existing and proposed ADP-1 project with requirement of major inputs resources are summarized in **Table 2.1.1**.

Table 2.1.1: Salient Features of the Existing and Post ADP-1 Refinery Complex of M/s Nayara Energy Ltd.

Sr. No.	Features	Details
1.	Crude Processing Capacity	**Existing Refinery** : 20 MMTPA **Post ADP-1** : 20 MMTPA
2.	Project Cost for ADP-1	Rs. 6200 Crores
3.	Cost of EMP for ADP-1	Rs. 10 Crores
4.	Total Project Area	40 Ha
5.	Water Requirement	**Existing Refinery** - 204 MLD Sea Water **Post ADP 1** – 221.3 MLD Sea Water (Existing facilities shall suffice the new requirement)
6.	Waste water generation and disposal to sea	**Existing Refinery** - Process effluent – 26 MLD, Saline water discharge – 134 MLD **Post ADP 1** – Process effluent – 27.1 MLD, Saline water discharge – 144.9 MLD
7.	Power Requirement	**Existing Refinery** - 160 MW by CPP **Post ADP 1** – 199 MW by CPP (Existing facilities shall suffice the new requirement)
8.	Air Emission (No. of Stacks)	**Existing Refinery** -17 Nos. **Post ADP 1** – 18 Nos. All Stacks are/will be provided with appropriate air pollution control system/measures.
9.	Hazardous Waste Management	Hazardous waste is/shall be handled as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
10.	Employment Generation	**Existing Refinery** - 1500 Nos. **Post ADP 1** - 1650 Nos. Contract workers during construction phase : 7000

2.1.2 Project Site Details – Location & Layout

Refinery complex is located approximately 39 Km away from Jamnagar on SH-25 on the way to Dwarka in Gujarat State on West coast of India.

Location of existing refinery complex is shown in **Fig. 2.1.1**, which will also house the proposed ADP-1 project within its premises. Additional land acquisition is not envisaged for the proposed ADP-1 project.

Toposheet of the area showing location of refinery complex is depicted in **Fig. 2.1.2**, whereas location on Google-Earth map is depicted in **Fig. 2.1.3**.

Location of refinery along with crude receipt & dispatch facility, sea water intake & return pipelines corridor, connecting refinery and Crude Oil Tankage (COT)/ Jetty etc. is shown in **Fig. 2.1.4**.

The plot plan layout of existing refinery and proposed ADP-1 project is shown in **Fig. 2.1.5**. Space available for green belt development is also demarcated.

Boundary coordinates of the refinery complex along with ADP-1 are given in **Table 2.1.2**, whereas other important details of the project site are summarized in **Table 2.1.3**.

Aerial view of the existing refinery and other photographs of the refinery complex are shown in **Plates 2.1.1 & 2.1.2**.

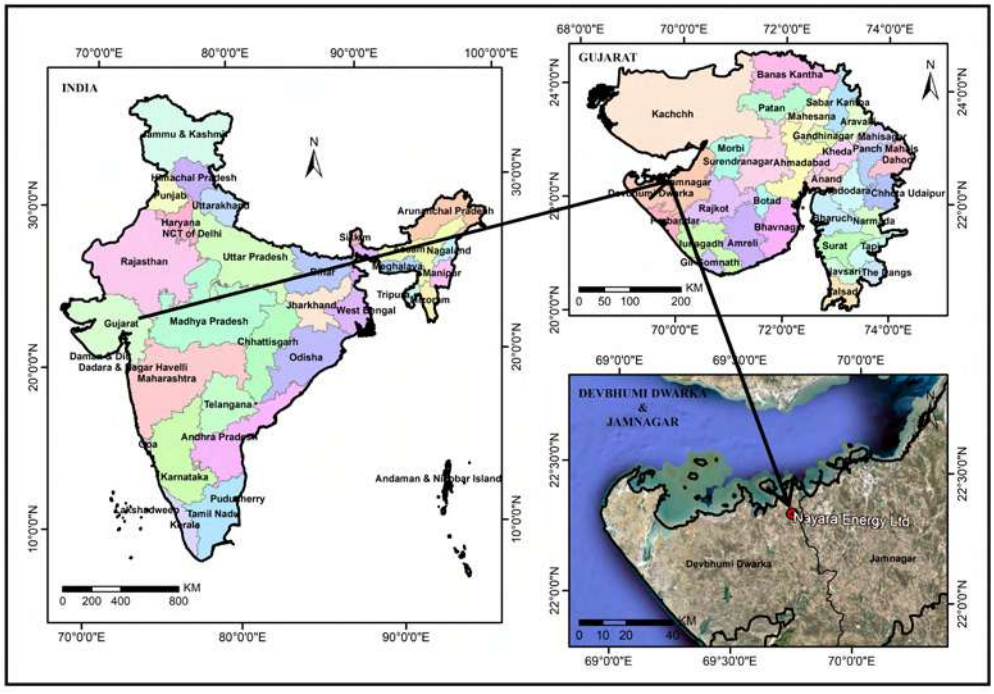


Fig. 2.1.1: Location of Existing Refinery with ADP-1 Project, M/s Nayara Energy Ltd. at Vadinar, Devbhumi Dwarka District, Gujarat

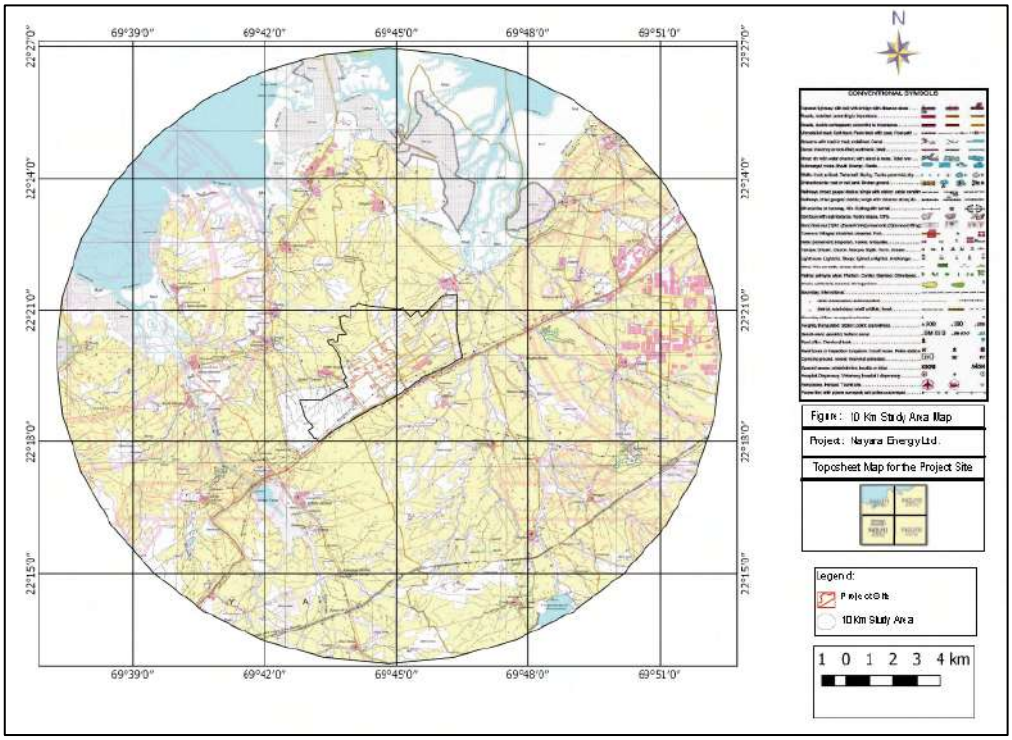


Fig. 2.1.2: Toposheet of Nayara Energy Refinery Complex (A2 Copy of Toposheet is attached separately)

Fig. 2.1.3: Google Earth Map Showing the Location of Nayara Energy Refinery

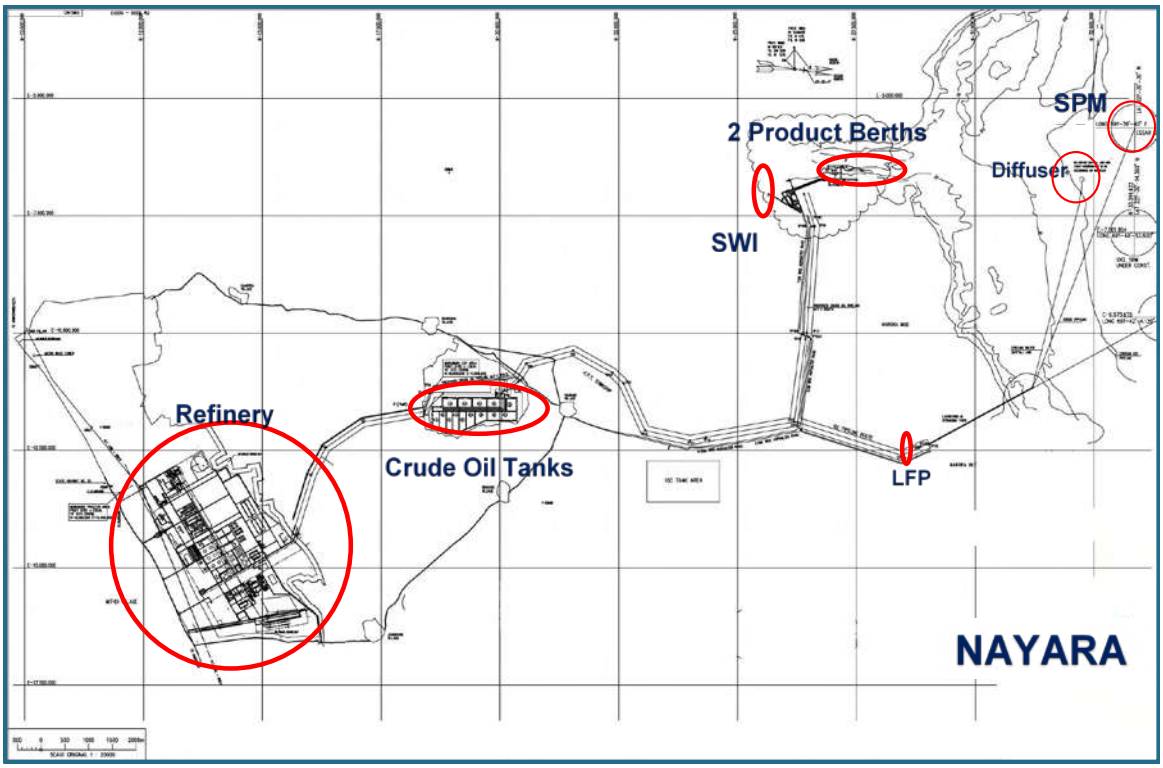


Fig. 2.1.4: Layout of the 20 MMTPA Refinery with ADP-1 Project

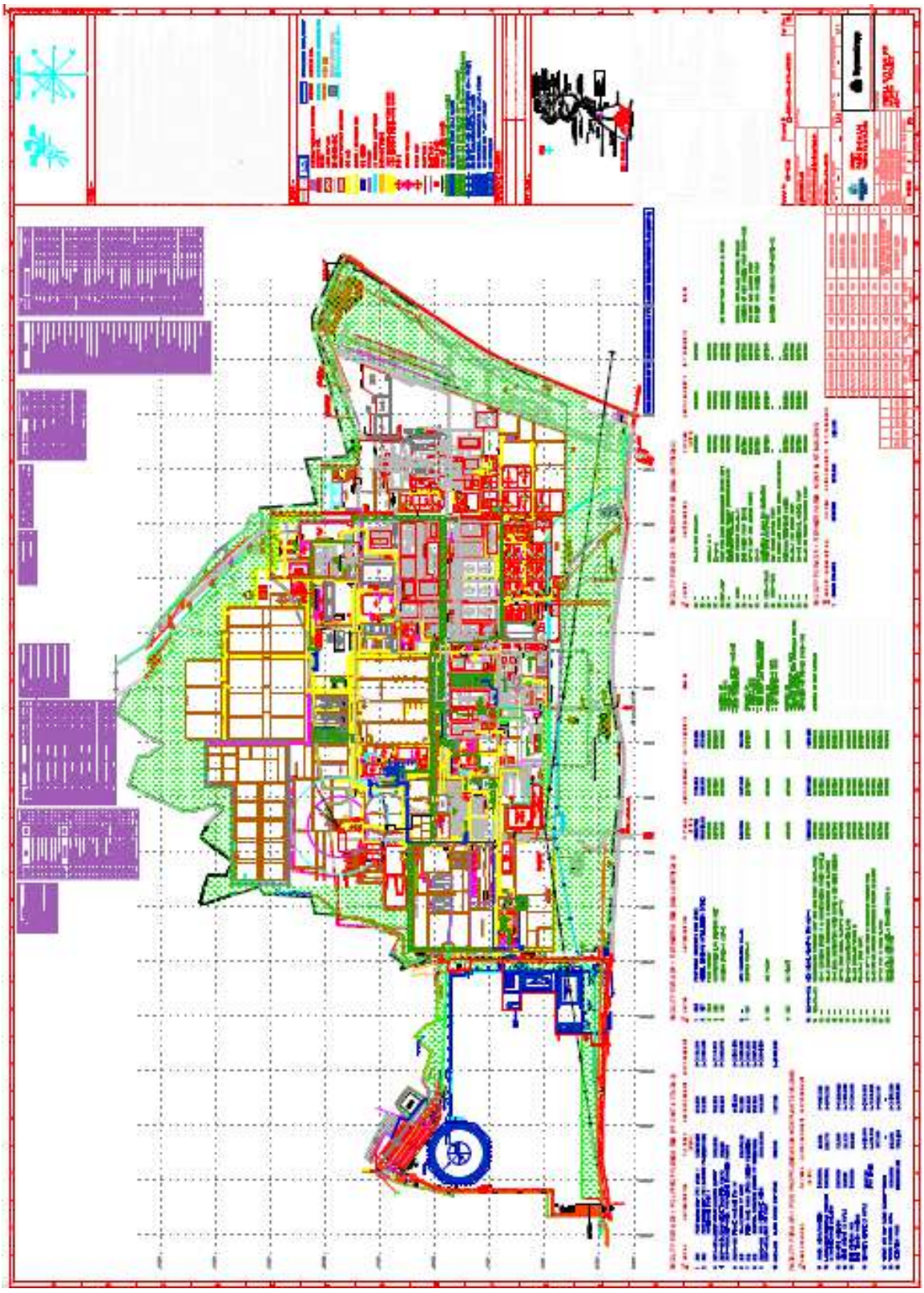


Fig. 2.1.5: Plot Plan Layout of Existing and Post ADP-1 Project (A0 map attached as Annexure 2.1)

Table 2.1.2: Boundary Coordinates of the Refinery Complex

Sr. No.	Direction	Latitude	Longitude
1	North	22°21'9.16"N	69°44'7.80"E
2	North East	22°21'21.63"N	69°46'23.02"E
3	East	22°19'54.73"N	69°46'30.25"E
4	South	22°17'59.04"N	69°43'14.50"E
5	West	22°18'57.56"N	69°42'47.82"E

Table 2.1.3: Salient Project Site Details

Sr. No.	Item	Details
1.	Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.	The project site falls under the villages namely Zankhar, Mithoi, Rasangpar & Modpar, under Taluka: Lalpur, District Jamnagar, and villages namely Sodha Taraghari, Timbadi, Kathi Devaria, Kajurada, Vadalia Sihan, under Taluka: Khambhaliya, District: Devbhumi Dwarka. Not Applicable as the proposed project is within the premises of existing refinery.
2.	Details w.r.t. option analysis for selection of site	Not Applicable as the proposed project is within the premises of existing refinery.
3.	Major industries within the 10km radius study area	M/s Essar Power Gujarat Ltd. (EPGL) is operating a Power Project of 1200 MW (2 X 600 MW) near Nana Mandha village, Jamnagar District in Gujarat.
4.	Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.	Not Applicable as the proposed project is within the premises of existing refinery.
5.	R&R details in respect of land in line with state Government policy	Not Applicable as the proposed project is within the premises of existing refinery.

Plate 2.1.1: Aerial View of the Existing Refinery

2.1.3 Project Schedule and Cost

The ADP-1 projects will be completed by 2023.

Project Cost:

The total cost of expansion project is estimated to be Rs. 6200 Crores.

Plate 2.1.2: Photographs Showing Existing Refinery Complex

2.2 Products of Existing and Post ADP-1 Refinery Complex

2.2.1 Product Slate of Existing and Post ADP-1 Refinery

The major two products of refinery are gasoline and diesel along with other products like LPG, Kerosene, ATF, Furnace oil, Sulfur, Petcoke, bitumen. Post ADP-1, there will be a new product for Nayara Energy which is Polypropylene. The product slate for the existing refinery, and Post ADP-1 are summarized in **Table 2.2.1**.

Table 2.2.1: Product Slate of Existing and Post ADP-1

Sr. No.	Products	Production Capacity (KTPA)	
		Existing Refinery (20 MMTPA)	Post ADP1 (20 MMTPA)
1.	LPG	938	1208
2.	Naphtha /MS	4,200	3540
3.	Gasoline		
4.	SKO/ATF	872	732
5.	Diesel/ HSD	9,706	10245
6.	Furnace Oil/VGO	220	35
7.	Sulphur	318	319
8.	Petcoke	2,247	2287
9.	Bitumen	377	-
10.	Polypropylene	-	450
11.	Fuel & Losses		
	a. Fuel	1,009	1066
	b. Losses	111	117

The above product slate may vary based on the Crude diet, Demand/Supply and Optimization.

2. 3 Process Description of Existing and Proposed ADP-1 Project

2.3.1 Process Units of Existing Refinery

The existing 20 MMTPA Refinery comprises of the following major process units:

- Crude Distillation Unit (CDU)
- Vacuum Distillation Unit (VDU)
- Fluidized Catalytic Cracker Unit (FCCU)
- Crude Distillation Unit-2 (CDU-2)
- Naphtha Hydro-treater/Continuous Catalytic Reformer Unit (NHT/CCR)
- Diesel Hydro-desulphurization Unit (DHDS)
- Mini Hydrogen Unit (MHMU)
- Base Sulphur Recovery Unit (SRU)
- Delayed Coker Unit -1 (DCU -1)
- Hydrogen Manufacturing Unit 1 (HMU-1)
- Hydrogen Manufacturing Unit 2 (HMU 2)
- Isomerization Unit (ISOM)
- Sulphur Recovery Unit -1 (SRU-1)
- De-hydro Diesel Treater Unit (DHDT-1)
- VGOMHC-1 Unit

- Sulphur Recovery Unit -2 (SRU-2)
- Amine Regeneration Unit (ARU 1 & 2)
- Sour Water Stripper Unit (SWS 1, 2 & 3)
- LPG Treater unit 1 & 2
- Unsat LPG Treater unit

2.3.2 Process Units under Proposed ADP-1 Project

The ADP-1 Project aims to utilize the existing refinery units by revamping FCC and Unsaturated LPG Treating Unit and to add Propylene Recovery Unit (PRU) and Polypropylene (PP) plant as mentioned below:

New Units -

- Propylene Recovery Unit (PRU)
- Polypropylene Unit (PP)

2.3.3 Process Unit Capacity Post ADP-1 Project

Details of different process units are given in **Tables 2.3.1**.

Table 2.3.1: Details of Process Units with Capacity for the Proposed ADP-1 Project

Sr. No.	Units	Capacity (KTPA)
1.	PRU	450
2.	PP	450

2.3.4 Process Description with Flow Diagram

Process details of each of the units of existing refinery and the new units in Proposed ADP-1 project are given along with process flow diagram in **Annexures 3 (A**, **B and C,** respectively).

2.4 Raw Materials Required, Sources and Mode of Transport

2.4.1 Crude Oil Slate for Existing and Proposed ADP-1 Project

The existing refinery primarily uses imported crude oil and the same source will be used for Crude post ADP-1 project.

Details of crude oil for the existing as well as for the proposed ADP-1 Project are given in **Table 2.4.1**. The configuration study has been carried out with the crude basket with following Crude mix having Blend API of 25.12 and 2.48 wt% sulphur.

Table 2.4.1: Crude Oil Slate for the Existing and Proposed ADP-1 Project

Sr. No.	Crude Blend	Existing Refinery - 20 MMTPA		Post ADP-1	
		Share (Wt%)	Capacity (MMTPA)	Share (Wt%)	Capacity (MMTPA)
1.	Arabian Heavy	9		6.3	1.26
2.	Arab Light	13.5		-	-
3.	Maya	27		-	-
4.	Doba	9		-	-
5.	Ratawi	31.5		-	-
6.	Mangala	10	2	5.9	1.17
7.	Basrah Heavy	-	-	33.2	6.65
8.	Dar Blend	-	-	5.1	1.01
9.	DCO	-	-	8.8	1.76
10.	Deodorised Field Condensate	-	-	2.5	0.5
11.	Djeno	-	-	7.5	1.5
12.	Iran Heavy	-	-	12.7	2.54
13.	Oriente Crude	-	-	8.3	1.66
14.	Roncador Heavy	-	-	2.0	0.41
15.	Soroosh	-	-	7.7	1.55
	Total	**100**	**20**	**100**	**20**

Depending upon the availability and pricing, crude oil can be taken from the national/international sources. The opportunity crude basket with sulphur content up to 3.5% may also be used. Existing Sulfur recovery unit is capable of handling this additional sulphur load.

2.4.2 Crude Receipt and Product Dispatch Facilities

2.4.2.1 Handling Facilities

Existing SPM with 27 MMTPA capacity was installed for crude receipts. SPM can handle VLCCs tankers. Crude is transferred to Crude Oil Tankages (COT) through pipeline. Finished products are dispatched through following modes:

- Rail gantry
- Road Tanker gantry
- GAIL LPG Pipeline
- Product Jetty (Berth-A/B)

Road Loading Facility

- Fully automated Loading Facilities
- 3-White Oil truck Gantries, each 8-Bays

- 2-LPG loading Gantries, each 8-Bays
- 1-Black Oil loading Gantry of 10-Bays
- Products : LPG, Gasoline, SKO, ATF, Diesel, FO and Bitumen, Petcoke

Rail Loading Facility

- Fully automated loading
- 48-Wagons Full rake siding
- Number of Spurs: Two
- Length of Gantry: 680 metres
- Products : Gasoline, SKO, Diesel & Fuel Oil, Petcoke

Jetty Loading/Unloading Facility

- Vessels handling: 25000 to 100,000 DWT
- Cargo handling: Naphtha, MS, SKO/ATF, HSD and Fuel Oil/ VGO, Crude Oil

Cross Country Pipelines

- Existing 3x24" Product pipelines from Refinery to Jetty
- Existing 1x48" Crude pipeline from SPM to Crude Oil Tankages

2.4.2.2 Mode of Crude and Product Transport

Following facilities are provided for handling crude and products:

- Single Point Mooring (SPM)
- Terminal (Jetty consisting of Berth A & B)
- Crude Oil Tanks
- Crude and product pipelines
- Product and Intermediate storage tanks
- Despatch facilities

Single Point Mooring (SPM)

The Single Point Mooring (SPM) is designed to receive crude from tankers including VLCC for meeting the Refinery crude throughput requirements. The crude is received into the crude oil tanks located in the crude oil tank farm (COT). The SPM is located at a distance of 8.4 km from the shore and 19 km away from the COT. The SPM is designed for a maximum unloading rate of 12,160 m^3/hr at 45 °C and 14 bar pressure. The crude unloading pipeline configuration is as follows:

1 x 48" offshore line approximately 9 km long (cement lined)

1 x 48" onshore line approximately 12 km long till end of COT

Terminal (Jetty)

The terminal provides facilities for ship loading of products as well as unloading of crude oil. Products are transported directly from the product storage area to the ships

through the product pipelines. The product jetty is located on the Pathfinder Creek at Vadinar site. Jetty is a part of refinery operation. It provides services to refinery for exporting finished products and importing crude.

Tanker sizes: 25,000 - 100,000 DWT tankers

Terminal facilities include:

- Ship loading/unloading
- Pipeline facilities (inclusive pig receiving / launching)
- Fire fighting facilities

To enable the flexibility to carry different products through one line, each line have its own pig launching and / or receiving facilities.

There are five loading arms in the terminal of the following configuration:

At Berth A: 2 of 12" & 1 of 16” (1 of 12” is used dedicatedly for FO/VGO/Crude Oil) for-At Berth B: 2 of 16”.

A slop tank of 550 m^3 has been established at Jetty for storage of slop. 550 m^3 Slop tank is connected with 8” pipeline and associated pumping system for slop transfer to Crude pipeline.

Bagging/ warehouse and loading facilities shall be installed for Polypropylene product. Majority of product evacuation for domestic sales shall be through road transport. For export of products or if needed for domestic sales, coastal movement through nearby port shall be used. Adequate additional storage facilities shall be installed for liquid intermediates (propylene from PRU).

2.4.3 Storage Facilities with Capacities for Existing and Proposed ADP-1 Project

Crude Oil Tankage (COT) is provided in between Marine area and Refinery for receiving crude from SPM. Product Intermediate Tankage (PIT) is provided in the complex for storage of products, fuel blends, and intermediate stock.

Crude Oil Tanks

Thirteen Crude Oil tanks along with associated facilities like pumps, fire water network etc. are provided for storage of crude oil. The capacities of ten tanks are 88,000 m^3 each and remaining three tanks are 1,20,000 m^3 each. Crude oil is pumped to refinery area via 32" and 24” pipeline. Details of tanks are given in **Table 2.4.2.**

Table 2.4.2: Details of Storage Tanks for Crude of the Existing Refinery

Sr. No.	Tank No.	Current Service	Nominal Capacity (m^3)	Diameter (m)	Height (m)
1.	60T-101	CRUDE	88000	80	20
2.	60T-102	CRUDE	88000	80	20
3.	60T-103	CRUDE	88000	80	20
4.	60T-104	CRUDE	88000	80	20
5.	60T-104	CRUDE	88000	80	20
6.	60T-106	CRUDE	88000	80	20
7.	60T-107	CRUDE	88000	80	20
8.	60T-108	CRUDE	88000	80	20
9.	60T-109	CRUDE	88000	80	20
10.	60T-110	CRUDE	88000	80	20
11.	160T-111	CRUDE	120000	92	20
12.	160T-112	CRUDE	120000	92	20
13.	260T-115	CRUDE	120000	92	20

Post ADP-1, quantity of crude handling remains same and hence no additional Crude Tank is envisaged.

Product and Intermediate Tanks:

Major functions of PIT area include:

- Receipt of Crude from COT area.
- Storing, preparing and transferring crude oil to the processing unit.
- Storing of final and intermediate products
- Product certification.
- Transfer of finished products to different areas like dispatch (for rail and road dispatch), terminal (for transfer through sea route), etc.

Existing Refinery has 128 tanks provided for storage of intermediate products and final products received from different process units. The tanks are of fixed roof or floating roof type depending on the products handled. Details of tanks are given in **Table 2.4.3.**

Post ADP-1 project there will be requirement of mounded bullets for storing propylene which is an intermediate product. The capacity and the number of propylene mounded bullet is given in **Table 2.4.4**.

Table 2.4.3: Details of Storage Tanks for Crude, Intermediate and Finished Products of the Existing Refinery

Sr. No.	Tank No.	Current Service	Nominal Capacity (m^3)	Diameter (m)	Height (m)
1.	61T001A	Crude Oil	16,000	38.0	14.4
2.	61T001B	Slop Oil	16,000	38.0	14.4
3.	151T001	Mangla Crude	30,411	44.0	20.0
4.	151T002	Mangla Crude	30,411	44.0	20.0
5.	161T520D	Sour VGO (VGO feed)	30,411	44.0	20.0
6.	161T520E	Sour VGO (VGO feed)	30,411	44.0	20.0
7.	161T520F	Vacuum Residue	30,411	44.0	20.0
8.	161T520G	Vacuum Residue	30,411	44.0	20.0
9.	161T506A	HSD BS IV	60,381	62.0	20.0
10.	161T506B	VGO	60,381	62.0	20.0
11.	61T220A	GMU Gasoline	15,000	36.0	15.0
12.	61T220B	Reformate	15,000	36.0	15.0
13.	161T220C	Light Gasoline	11,533	32.0	20.0
14.	161T220D	Light Gasoline	11,533	32.0	20.0
15.	61T221A	Reformate	15,000	36.0	15.0
16.	61T221B	Reformate	15,000	36.0	15.0
17.	161T240A	Coker Naphtha	15,000	30.0	16.5
18.	161T240B	Coker Naphtha	15,000	30.0	16.5
19.	61T222A	NHT HY NAP	6,500	24.0	15.0
20.	61T222B	NHT LT NAP	6,500	24.0	15.0
21.	61T222C	NHT LT NAP	6,500	24.0	15.0
22.	161T222D	SKO	30,000	44.0	20.0
23.	161T230A	Isomerate	11,533	30.0	16.4
24.	161T223A	MS BS IV	60,381	62.0	20.0
25.	161T223B	MS EXP	60,381	62.0	20.0
26.	161T223C	MS BS IV	30,411	44.0	20.0
27.	161T223D	MS BS IV	30,000	44.0	20.0
28.	61T250A	MS BS IV	15,000	36.0	15.0
29.	61T250B	MS BS IV	15,000	36.0	15.0
30.	61T250C	Sour Naptha	15,000	36.0	15.0
31.	61T250D	MS BS IV	15,000	36.0	15.0
32.	61T250E	MS BS IV	15,000	36.0	15.0
33.	61T250F	MS BS IV	15,000	36.0	15.0
34.	61T260A	MS BS IV	30,000	50.0	16.0
35.	61T260B	Naphtha	30,000	50.0	16.0
36.	61T260C	Naphtha	30,000	50.0	16.0

37.	61T260D	Naphtha	30,000	50.0	16.0
38.	61T301	CDU KERO	4,000	20.0	13.5
39.	61T350A	ATF	10,000	30.0	15.0
39.	61T350B	SKO	10,000	30.0	15.0
41.	61T350C	ATF	10,000	30.0	15.0
42.	61T350D	SKO	10,000	30.0	15.0
43.	61T351A	ATF	10,000	30.0	15.0
44.	61T351B	ATF	10,000	30.0	15.0
45.	161T351C	HSD BS IV	30,000	44.0	20.0
46.	161T351D	ATF	30,000	44.0	20.0
47.	161T351G	DHDS Feed	30,000	44.0	20.0
48.	161T351H	DHDS Feed	30,000	44.0	20.0
49.	61T402	Wash Oil	4,000	20.0	13.5
50.	61T422A	CDU HY Naptha	3,000	18.0	12.0
51.	61T422B	NHT LT NAP	3,000	18.0	12.0
52.	61T424A	DHDS Feed	30,000	50.0	16.0
53.	61T424B	DHDS Feed	30,000	50.0	16.0
54.	161T351E	HSD BS IV	30,000	44.0	20.0
55.	161T351F	HSD BS IV	30,000	44.0	20.0
56.	61T450A	HSD BS IV	50,000	62.0	16.2
57.	61T450B	HSD BS IV	50,000	62.0	16.2
58.	61T450C	HSD BS IV	50,000	62.0	16.2
59.	61T450D	HSD BS IV	50,000	62.0	16.2
60.	61T450E	HSD BS IV	50,000	62.0	16.2
61.	61T450F	HSD BS IV	50,000	62.0	16.2
62.	161T450G	HSD BS IV	60,000	62.0	20.0
63.	161T450H	HSD BSII	60,000	62.0	20.0
64.	161T450I	HSD BSII	60,000	62.0	20.0
65.	61T502	Slurry Oil	2,500	18.0	10.0
66.	61T503A	LSFO	20,000	40.0	16.2
67.	61T503B	LSFO	20,000	40.0	16.2
68.	61T503C	Vacuum Residue	20,000	40.0	16.2
69.	61T503D	Vacuum Residue	20,000	40.0	16.2
70.	61T520A	VG 30	10,000	30.0	15.0
71.	61T520B	VG 40	10,000	30.0	15.0
72.	61T520C	VG 30	10,000	30.0	15.0
73.	161T424C	Vacuum Residue	30,411	44.0	20.0
74.	61T550A	Vacuum Residue	10,000	30.0	15.0
75.	61T550B	Vacuum Residue	10,000	30.0	15.0
76.	61T560A	Slop Oil	20,000	40.0	16.2
77.	61T560B	Mangla Crude	20,000	40.0	16.2
78.	61T560C	Sour VGO (VGO Feed)	20,000	40.0	16.2

79.	61T560D	Sour VGO (VGO Feed)	20,000	40.0	16.2
80.	61T552A	VG 30	3,000	18.0	12.0
81.	61T552B	VG 30	3,000	18.0	12.0
82.	61T552C	VG 40	3,000	18.0	12.0
83.	61T552D	VG 40	3,000	18.0	12.0
84.	61V920A	VG 30 Vessels	47	-	-
85.	61V920B	VG 30 Vessels	47	-	-
86.	61V920C	VG 30 Vessels	64	-	-
87.	61V920D	VG 30 Vessels	64	-	-
88.	61T601	Slop Oil	500	10.0	7.2
89.	61T620	Slurry Oil	1,000	14.0	7.2
90.	61T622	Slop Oil	5,000	22.0	14.4
91.	61T124A	LPG Sphere	3,600	19.0	-
92.	61T124B	LPG Sphere	3,600	19.0	-
93.	61T124C	LPG Sphere	3,600	19.0	-
94.	61T124D	LPG Sphere	3,600	19.0	-
95.	61T125A	LPG Sphere	3,600	19.0	-
96.	61T125B	LPG Sphere	3,600	19.0	-
97.	61T125C	LPG Sphere	3,600	19.0	-
98.	61T125D	LPG Sphere	3,600	19.0	-
99.	61T-701A	Hydrogen Sphere	600	10.5	-
100.	61T-701B	Hydrogen Sphere	600	10.5	-
101.	61T-701C	Hydrogen Sphere	600	10.5	-
DESPATCH					
102.	77T-100A	LPG	3600	19.0	-
103.	77T-100B	LPG	3600	19.0	-
104.	77T-100C	LPG	3600	19.0	-
105.	77T-100D	LPG	3600	19.0	-
106.	77T-200A	MS BS-IV	4000	20.0	13.5
107.	77T-200B	MS BS-IV	4000	20.0	13.5
108.	77T-201	MS BS-IV	500	10.0	9.0
109.	77T-202	MS BS-IV	500	10.0	9.0
110.	177T-302B	MS BS-IV	5000	18.0	20.0
111.	77T-301A	CETANE IMPROVER	900	12.0	10.0
112.	77T-301B	SKO	900	12.0	10.0
113.	177T-300A	SKO	5000	24.0	14.0
114.	77T-302	HF-HSD	200	9.0	5.4
115.	177T-302C	HF-HSD	5000	18.0	20.0
116.	77T-400A	HSD BS-IV	10000	30.0	15.0
117.	77T-400B	HSD BS-IV	10000	30.0	15.0
118.	77T-401A	HSD BS-IV	3000	17.5	13.5
119.	77T-401B	HSD BS-IV	3000	17.5	13.5

120.	177T-500C	HSD BS-IV	5000	18.0	20.0
121.	77T-500A	HSFO	4000	20.0	13.5
122.	77T-500B	HSFO	4000	20.0	13.5
123.	77T-501A	HSFO	800	10.0	10.8
124.	77T-501B	HSFO	800	10.0	10.8
125.	77T-502A	Bitumen	800	10.0	10.8
126.	77T-502B	Bitumen	800	10.0	10.8
127.	77T-701A	Ethanol	540	9.0	10.5
128.	77T-701B	Ethanol	628	10.0	10.0

Table 2.4.4: Details of additional Storage/ Mounded Bullets for ADP1 Project

Sr. No.	Product/ Feed	Nominal Capacity (m^3)	Proposed No.
1.	Propylene Mounded Bullets	3621	3
	Total Tanks		**3**

2.5 Infrastructure and Resource Requirements

2.5.1 Land Requirement

Adequate land is available at the project site of existing refinery and there is no further land requirement for the proposed ADP-1 project. Total land available is 2275 ha (plant area including open spaces like roads and safe distances and future expansion). Breakup of land utilization for facilities in existing and proposed ADP-1 project is given in **Table 2.5.1**.

Table 2.5.1: Details of Land Availability/ Requirement

Sr. No.	Land Use	Existing Refinery (ha)	Total Utilized land Post ADP-1 (ha)
1.	Plant Area (including open spaces like Roads and safe distances)	761	801
2.	Green Belt	410	410
Total		**1171**	**1211**

Greenbelt area shall be 33% of total area of existing as well as proposed ADP-1 project.

2.5.2 Water Requirement Details

2.5.2.1 Water Requirement/Consumption and Source

Existing Refinery water needs are met by Sea water. For proposed project also the sea water is proposed to be used. The total water requirement/ consumption details for the existing and post ADP-1 project are given in **Table 2.5.2**.

Table 2.5.2: Water Consumption Details for Existing and Post ADP-1 Refinery Processes

Sr. No.	Purpose	Water Requirement/ Consumption (MLD)			Source
		Existing	Post ADP-1	Ultimate	
A. Sea Water					
1.	Desalination Plant Feed	154	17.3	171.3	Sea Water
2.	Cooling Towers Make up	50	-	50	Sea Water
Total		**204**	**17.3**	**221.3**	
B. Sweet Water					
3.	Domestic	4.5	0.1	4.6	Desalination Plant,
4.	Cooling Tower	17	5.9	22.9	RO/Desalination Plant
5.	Boiler	37	0.6	37.6	Desalination Plant
Total		**58.5**	**6.6**	**65.1**	

Based on above, the additional Sea water requirement for "ADP-1 project" shall be approximately 17.3 MLD and total projected sea water demand post ADP-1 Refinery Project works out as 221.3 MLD.

2.5.2.2 Sea Water Intake & Return System

The sea water intake facility sources sea water which is pumped through pipeline and is utilized by desalination plant, sea water cooling tower. Water requirement for the refinery is met through seawater intake facility located in the Pathfinder creek. The facility consists of a seawater intake well to the south of the Deendayal Port Trust (DPT) jetty; pump house and a 44 inch GRP pipeline from the Pump House to the Refinery complex. Chlorine-dosing package is installed at the pump house to prevent marine growth in the intake system. This seawater after filtering is utilized for cooling as well as to produce freshwater through desalination. The return water is discharged through 52 inch pipeline and diffuser.

Existing Sea water supply & return infrastructure is sufficient to handle the additional water requirement.

2.5.2.3 Sweet Water Requirement for the existing Refinery and Proposed ADP-1

Sweet water requirement post ADP-1 project is estimated to be about 11.4 MLD, wherein as much as 4.8 MLD (42%) water will be recycled from return condensate and effluent/wastewater treatment, thus reducing the net water requirement to 6.6 MLD. Breakup of water requirement is given in **Table 2.5.3**.

Table 2.5.3: Sweet Water Requirement Post ADP-1 Project

Sr. No	Streams	Quantity (MLD)
1.	CT make up	6.4
2.	DM + BFW (for Steam/Power)	4.5
3.	Service water	0.2
4.	Fire Water make up + Horticulture	0.2
5.	Potable Water	0.1
	Total (A)	**11.4**
6.	Return Condensate	3.9
7.	Treated effluent for SW+FW+HT	0.4
8.	ETP RO water for CT Make-up	0.5
	Total (B)	**4.8**
Net Water Consumption (A-B)		**6.6**

2.5.2.4 Wastewater Generation, Treatment and Disposal

A. Wastewater Generation Details

Wastewater generation from process is 26 MLD for existing that will become 27.1 MLD post ADP1 and will be used for Fire water/Service water, RO feed, Cooling tower makeup, Horticulture after treatment. Sea water based cooling tower blow down is 36.5 MLD for existing is being returned to sea via pipeline and released through diffuser as given in the table below. Similarly, brine from the desalination/RO units are discharged in the sea. Currently, 134 mld of sea water brine including sea cooling water blowdown is discharged in the sea through 52" return header and diffuser. The estimated quantity of Sea Water Brine for the proposed project will be 10.9 MLD. With this the total brine from the desalination/RO units including sea cooling water blowdown to sea, post ADP1, works out to be 144.9 MLD. Details of wastewater generation through different processes is given in **Table 2.5.4**.

The existing infrastructure for sea water return will be able to handle this additional load.

Table 2.5.4: Details of Wastewater Generation through Different Processes

Sr. No.	Purpose	Wastewater Generation (MLD)			Remarks
		Existing Refinery	Post ADP-1	Total	
1.	Process	26	1.1	27.1	To be used after treatment for Fire water/ Service water/CW make up/ Horticulture etc. (includes domestic waste water)
2.	Cooling Tower blow Down (Sea Water)	36.5	-	36.5	Return to sea via pipeline and is released through diffuser.
3.	Desalination/ RO Reject	97.5	10.9	108.4	

B. Waste Water Treatment Facilities

The wastewater treatment facilities shall handle salt and sweet waste water from the refinery process, tankage, loading and utility areas. Refinery effluent water contains various hydrocarbon components in addition to suspended solids, organic acids and sulphur compounds. The nature of the components depends on the constituents of the inlet crude oil as well as the processing scheme of the refinery. Most of these constituents would be undesirable in the effluent water, so it is necessary to treat the water to remove the contaminants.

The treatment scheme includes coagulation & flocculation, aerobic oxidation followed by Tertiary treatment. This treatment process will make water suitable for feeding to RO unit & for utilizing in other purposes such as service water, horticulture & fire water. Existing refinery has Effluent treatment plant having design capacity of 30 MLD. Currently the waste water generation is approximately 26 MLD.

Proposed ADP-1 Project is expected to generate about 1.1 MLD effluent from various streams which will be sent to the existing WWTP. Which will make the total waste water load to 27.1 MLD. ***The existing WWTP is sufficient to handle this additional load.***

The treated water shall be reused for service water, Fire water make up, CW make up and horticulture.

2.5.3 Power Requirement

The power requirement of the existing Refinery is met by captive power plant which has coal/ NG/ FO/ FG / CSO/HSD based steam and power generators. Details of existing power generation facilities are given in **Table 2.5.5**.

Table 2.5.5: Details of the Existing Power Generation Facilities

Sr. No.	Existing Asset	Fuel Used	Power Capacity (MW)
1.	77 MW Power Plant	Refinery FO, Refinery fuel gas	38.5 x 2 = 77
2.	220 MW Gas based Power Plant	NG or HSD/ Naptha/ LCO	110 x 2 = 220
3.	303 MW Coal based Power Plant	Coal or Fuel Oil/ CSO/ HSD/ LDO	105 x 2 + 92.8 x 1 = 303

The total power requirement for ADP-1 is expected to be around 39 MW. The total power requirement including existing requirement shall be (39+160) 199 MW.

The existing facility is sufficient to meet the power requirement post ADP-1 project.

2.5.4 Desalination Units

Desalination unit of suitable capacity shall be installed to meet the ADP-1 requirement of sweet water. Desalinated water shall be supplied for uses including cooling water make up, DM water feed and potable water.

2.5.5 Cooling Water Facilities (CWF)

Existing system handles the cooling water required for cooling services in the Refinery complex as given below.

A. Sea Water Cooling System

Sea water is received from jetty to the refinery site and is being distributed to the Base refinery process and utility units through the circulation pumps.

A bank of induced draft cooling tower is provided for cooling hot process cooling water. The cooled water is collected in the cooling water tower basin constructed below the cooling tower. From these basins the water is supplied to the process units through the distribution network. The heater cooling water is returned from the process and utility units to the top of the cooling water towers and flows down over the cooling water tower internals meanwhile exchanging heat with air originating from the environment.

Any loss from the cooling water due to evaporation, drift and blow down is make up through sea water.

B. Sweet Water Cooling System

Sweet water is supplied to the Refinery through Train-1 Sweet Water Cooling Towers. The cooling towers make- up is supplied from the below sources:-

- Low salt water from Desalination System
- RO permeate Water

Circulating water is distributed to the several services of Train-1 expansion Process and Utility units by the circulation pumps.

The sweet cooling water circulation is provided with a sweet cooling water surge vessel. Design Capacity is 36 MLD.

Details of existing Sea and Sweet water Cooling System are summarized in **Table 2.5.6.**

Table 2.5.6: Details of Existing Sea and Sweet Water Cooling System

Sr. No.	Unit	Design Capacity (MLD)
A.	**Sea water Cooling System**	
1.	Process Cooling Tower	896
2.	Utility Cooling Tower	640
B.	**Sweet Water Cooling System**	
1.	Cooling Tower-1	336
2.	Cooling Tower-2	672
3.	Cooling Tower-5	168

To meet ADP-1 cooling water requirement, new cells will be added to Cooling Tower-01 and Cooling Tower-05.

2.5.6 DM Plant/ Condensate Polishing Plant

DM water is mainly required for steam generation in power plant of the refinery. The Demineralized water is produced from low salt water, RO permeate water, clean suspect condensate. The suspect steam condensate are polished to make it suitable for reuse.

Post ADP-1 project condensate polishing requirement increases by 3.9 mld and to cater that, condensate polishing unit of suitable capacity shall be provided.

2.5.7 Air Separation Unit (ASU)/ Nitrogen Generation Unit (NGU)

Nitrogen is obtained from an air separation unit from which 1850 Nm^3/hr pure nitrogen can be withdrawn from Base NGU plant and 6000 Nm^3/hr train-1 expansion NGU plant. The purity of this nitrogen is over 99.9 volume% with less than 5 ppm-volume oxygen. The nitrogen is required for the various process units and also required for purging and blanketing of storage tanks.

Post ADP-1 project, total Nitrogen requirement shall increase by approximately 5000 Nm3/hr. Some of the requirement are of continuous nature and apart from this different peak requirements will also be there. Suitable capacity of NGU with gaseous as well as liquid generation facility shall be installed to meet the expansion requirement.

2.5.8 Air Generation Unit (AGU)

Instrument and plant air is supplied for the refinery by Air generation unit. Design capacity of Base AGU plant is 25355 Nm^3/hr and Train-1 expansion AGU plant is 51500 Nm^3/hr.

Compressed air is flowing to a common receiver. Plant air is being taking directly from the receiver. The instrument air is first pass through air driers for removal of moisture. Separate plant and instrument air headers are being used to distribute compressed air throughout the refinery.

The existing system/facility is sufficient to meet the refinery Plant Air and Instrument Air requirement post ADP-1 implementation. However to meet the compressed air requirement of new Nitrogen plant of ADP1, new air compressors of suitable capacity shall be provided.

2.5.9 Fuel Gas/Oil Storage and System

The main objective of refinery fuel gas and fuel oil system is to supply fuel gas and fuel oil to the various consumers of the Nayara Energy Ltd.

A) Fuel gas

The system consists of followings:

- A fuel gas production system (vaporizer) lined up from fuel gas producing units to the fuel gas drum.
- A fuel gas mixing drum.
- A fuel gas supply grid starting at fuel gas mixing drum and leading to fuel gas consumers plant battery limits.
- A LPG vaporizer discharging gas in the fuel gas drum.
- Two LPG supply headers (from PIT and MERICHEM units).
- Design Capacity of FG system is 110 TPH.

Existing Infrastructure of Fuel Gas System will suffice for ADP-1 requirement.

B) Fuel oil system

There are two Fuel oil hold up tanks. Two storage tanks are provided to allow simultaneous receipt, storage and supply of fuel oil. Design Capacity of FO system is 100 TPH.

No additional Fuel Oil requirement is envisaged post ADP-1 and hence existing system of Fuel Oil will suffice post ADP-1 project.

2.5.10 Fire Protection System

The function of the firewater facilities is to provide fire protection and fire-extinguishing systems for the refinery, crude storage and terminal. Each of these locations have an independent firewater system. The firewater system is covered by an underground firewater header with hydrants, monitors, fixed water spray systems and semi-fixed foam systems.

In the refinery, treated sweet water is used as firewater and seawater is used as backup. The design flow rate in the refinery area is 168 MLD.

In the crude storage area, rainwater/ service water is used as firewater and seawater is used as backup. The design flow rate in the crude storage area is 84 MLD.

Post ADP-1 project, existing Fire-Protection System will be augmented to cater the need of the project as per latest OISD guidelines.

2.5.11 Manpower

The total permanent manpower requirement for operation for ADP-1 is estimated to be about 150 persons. In addition approximately upto 7000 persons will be engaged as contract workers during construction period through the contractors. The existing refinery has about 1500 permanent employees.

All the facilities required for the contractual labour during construction phase shall be in the scope of outsourcing agency doing that particular civil, mechanical, electrical job etc. and will form a part of bid document. Permanent employees shall also be provided all the requisite facilities as per the policy of the company.

2.6 Emission Control System/ Disposal Mechanism

Air pollution is one of the major concerns in petroleum refinery, as large amount of sulphur dioxide and nitrogen dioxide emissions could be released into the atmosphere, if not recovered/ controlled properly. Air pollution issues are adequately addressed in the existing refinery by adopting number of control measures, such as:

- ✓ Installed Low Temperature Shell Claus off Gas Treating Units (LT SCOT) at sulphur recovery unit.
- ✓ Installed Multistage multiple Cyclones in Fluidized Catalytic Cracking & Regeneration unit for particulate emission control.
- ✓ **Installed Amine Absorbers -** The fuel gas produced in the refinery contains H_2S. This is removed in the Amine absorber columns and the sweet gas is routed to Refinery fuel gas system. Subsequently H_2S is stripped out from rich amine in amine regeneration unit. Lean amine is reused while H_2S is sent to sulphur recovery unit.
- ✓ **Use of Low Sulphur Fuel -** Refinery fuel Gas, Natural gas and Fuel Oil are used as fuel in heaters / furnaces. Average sulphur content in the fuel oil is less than 1 %.
- ✓ Installed Low NO_X burners in all heaters / furnaces.
- ✓ Installed Sulphur Recovery Unit having sulphur recovery efficiency more than 99.5%.

- ✓ **Floating roof tanks:** Floating roof tanks are provided for storage of class A products; this reduces HC vapour loss. Double seal has been provided in order to minimize vapour leakage.
- ✓ **Good Flare Management-** all vent offs are connected to the flare to take care emergency releases from refinery plant.
- ✓ All access roads (internal as wells as external) which is being used are paved either with concrete or bitumen to suppress the dust generation along the roads.

Like existing refinery, all the process units under proposed ADP-1 shall be equipped with adequate pollution control systems that will help to reduce any environmental risks/adverse environmental impacts on the receiving environment.

Status of existing as well as proposed pollution control measures adopted/to be adopted for control of air pollution, noise, waste water treatment, solid and hazardous waste management is discussed in details in subsequent chapters.

In case of certain grade of Polypropylene production, which shall happen for few days in a year's operation, some amount of VOC emission (normal-270 mg/Nm3, Design-500 mg/Nm3) is expected. Adequate capacity Thermal oxidiser shall be provided to handle it and to bring the VOC emission within permissible limit.

2.6.1 Sulphur Balance for the Existing and Post ADP-1 Refinery Complex

Sulfur balance for the existing refinery and Post ADP-1 project is given in **Table 2.6.1**.

Table 2.6.1: Sulphur Balance for the Existing Refinery and Post ADP-1 Refinery

Sr. No.	Crude Processed	MMTPA	Existing	Post ADP-1
1.	Avg. Sulphur content	Wt%	2.63	2.48
2.	Total Sulphur Intake	MMTPA	0.53	0.50
3.	Total Sulphur Intake	TPD	1,503	1,417
4.	Total Sulphur content in Products	TPD	448.6	396.1
5.	Sulfur in stack emission	TPD	6.7	6.7
6.	Total sulphur Intake to SRU	TPD	**1048**	**1014**
7.	Sulphur recovery Cap already Installed	TPD	440	440
8.	New capacity added	TPD	1,350	1,350
9.	Additional Capacity required	TPD	--	--
	Sulphur recovered:			
10.	SRU Efficiency for Old Units		99.0%	99.0%
11.	SRU Efficiency for New Units		99.9%	99.9%

12.	Sulphur recovered	TPD	1,046	1013
	Emission:			
13.	**SO_2 Emission**	**TPD**	**16**	**16**

The Crude basket selected for the ADP-1 project shall contain 2.48 wt% Sulphur. However, the opportunity crudes basket with sulphur contents up to 3.5 wt% may also be used. In such cases also, the capacity of the existing sulphur recovery unit will suffice.

Chapter 3

Description of the Environment

Chapter 3

Description of the Environment

3.1 Air Environment

3.1.1 Air Quality Monitoring Details

In order to establish background levels of air quality in the study area (10 km radius area of the proposed ADP-1 project), monitoring was carried out at nine locations during Summer 2018. The sampling locations were selected based on guidelines of network siting criteria such as:

- Topography of the study area
- Representation of regional background
- Populated and sensitive areas
- Screening of maximum ground level concentrations and distances of their likely occurrences as per climatological normal
- Representation of valid cross sectional distribution in downwind direction

Monitoring locations with respect to the Refinery are depicted in **Fig. 3.1.1** and details of these locations are given in **Table 3.1.1**. Four locations were within 5 km radius from the plant, whereas 4 locations were between 5 & 10 km radius from the plant and one represented the air quality status within the refinery complex.

All the 12 parameters indicated in the NAAQS were monitored, with two additional parameters; vanadium and hydrocarbons, specific to the refinery. The monitoring was carried out during Summer 2018 (April-June), with few observations taken during the month of March also. Parameters like PM_{10}, $PM_{2.5}$, Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_2) were monitored twice in a week, whereas other parameters like Carbon Monoxide (CO), Ammonia (NH_3), Hydrogen sulphide (H_2S), Lead (Pb), Arsenic (As), Nickel (Ni), Vanadium (V), Benzene, Benzo (α) Pyrene, Hydrocarbon, and Volatile Organic Compounds were monitored fortnightly. Standard analytical procedures were used for collection of samples, analysis and quantification of air quality parameters and are given in **Table 3.1.2**.

Photographs of the sampling stations/locations are given in **Plate 3.1.1**.

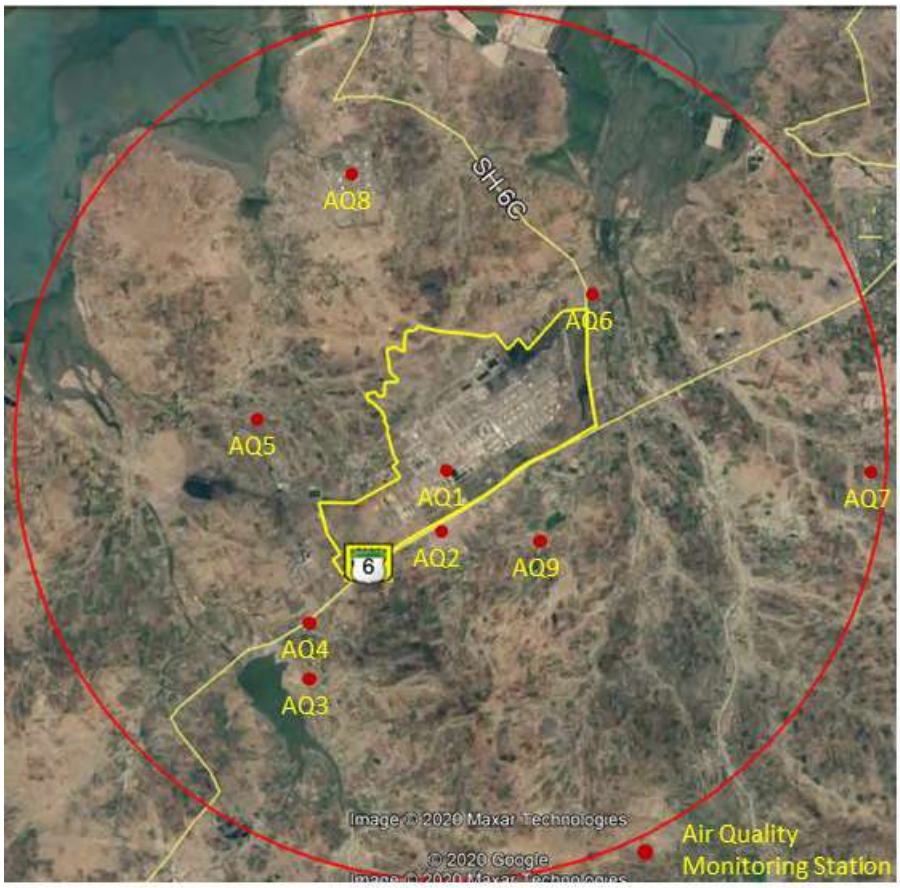


Fig. 3.1.1: Map for Air Quality Monitoring Locations in the Study Area

3.1.2 Air Quality Status during Summer 2018

The ambient air quality data with respect to different parameters are given in **Tables 3.1.3** and **3.1.4**, and are briefly described here.

- The period average concentrations of PM_{10} and $PM_{2.5}$ at all the nine sampling locations varied in range of 74-100 µg/m^3 and 22-32 µg/m^3 respectively, which mainly represent the particulate matter concentration of rural environment and can be attributed to soil dust in the region. The highest concentration of particulate matter was observed at Kajurda Patiya, whereas minimum concentration was observed in COT area for both PM_{10} and $PM_{2.5}$.
- 24 hourly maximum concentration of PM_{10} was found more than the NAAQS at 6 locations, highest being at village Kajurda Patiya, however, the maximum concentration of $PM_{2.5}$ was always found below the NAAQS.

- The period average concentration of SO_2 and NO_2 varied between 17-23 µg/m^3 and 23-29 µg/m^3, respectively. The 24 hourly maximum concentration of SO_2 (31 µg/m^3) and NO_2 (36 µg/m^3) was observed at Kajurda Patiya, Kajurda Village and Padana Village, whereas minimum levels of SO_2 and NO_2 were observed at Zankhar Village and Refinery Township respectively.
- Levels of other gaseous pollutants at all the locations were recorded as: CO (<1.0 mg/m^3), NH_3 (<20 µg/m^3), Benzene (1.0 µg/m^3) and Benzo-a-pyrene (< 0.1 µg/m^3), which were found within the respective NAAQS.
- Levels of heavy metals were such as lead (Pb), Arsenic (As), Nickel (Ni) and vanadium (V) and VOCs were found below the detectable limits.

Daily concentration levels of PM_{10}, $PM_{2.5}$, SO_2 and NO_2 at different sampling locations are given in **Annexure 4 (Tables A4.1 - A4.9).** All the values were found mostly within the respective NAAQS, except few values of PM_{10} exceeding the limit occasionally, which may be attributed to rural background activities.

3.1.3 Air Quality Status during 2017-18

As an environmental compliance, air quality monitoring was carried out within the refinery premises at 5 locations by a third party; NABL Accredited and MoEF&CC recognized Laboratory (M/s Unistar Environment & Research Lab Pvt. Ltd., Vapi). Sampling protocol of once a week monitoring is followed. The air quality parameters monitored include PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, Benzene and Benzo(a)-Pyrene. Sampling is carried out on 24 hourly basis during 2017-18. The five selected sampling locations are; A93 Gate, Refinery Main Gate, Labour Gate, Port A Camp and COT area. The sampling locations are shown in **Plate 3.1.2.**

Statistical summary in terms of minimum, maximum, average and 98th percentile values of key pollutants (PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO) is given in **Table 3.1.5**. Perusal of the table indicates that average PM_{10} levels remained within the NAAQS at all the locations, and also other pollutants, like $PM_{2.5}$, SO_2, NO_2 and CO were found well below the NAAQS. The levels are more or less uniformly distributed in the region. High levels of PM_{10} are attributed to regional rural setting and road dust re-suspension due to movement of vehicles.

In addition, two continuous ambient air quality monitoring stations have installed in the upwind and downwind direction of the refinery. The data is connected to the CPCB server online.

3.1.4 Meteorological Data Analysis

An automatic weather station is installed within the existing plant, which records all micro-meteorological parameters like wind speed, wind direction, ambient

temperature, and relative humidity. Meteorological tower and sensors are shown in **Plate 3.13**.

Micro-meteorological data was collected for the period from January 2017 to June 2018, which also included air quality study period of Summer 2018, are given in **Table 3.1.6.**

Monthly variations in meteorological parameters (temperature, relative humidity and wind speed) are presented through **Figs. 3.1.2, 3.1.3** and **3.1.4** respectively.

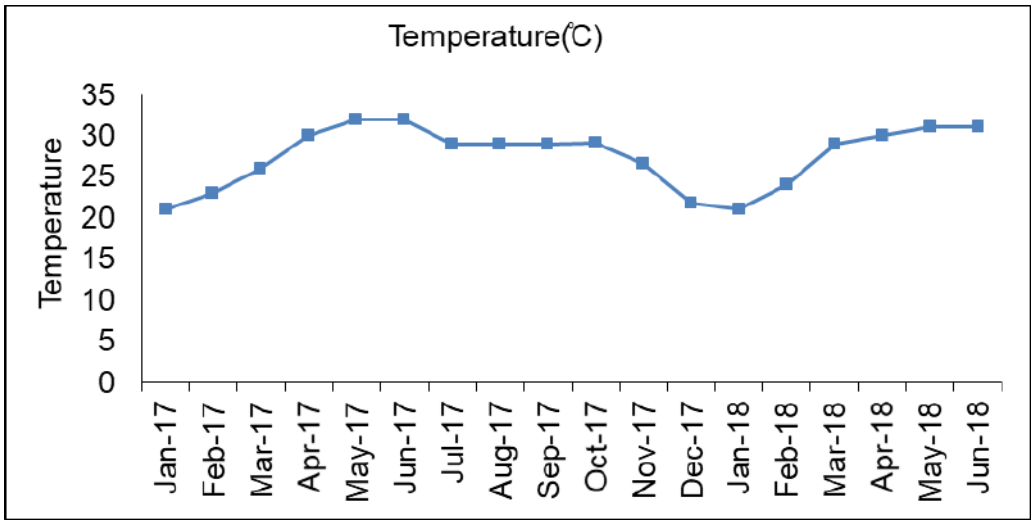


Fig. 3.1.2: Temperature variation during January 2017 to June 2018

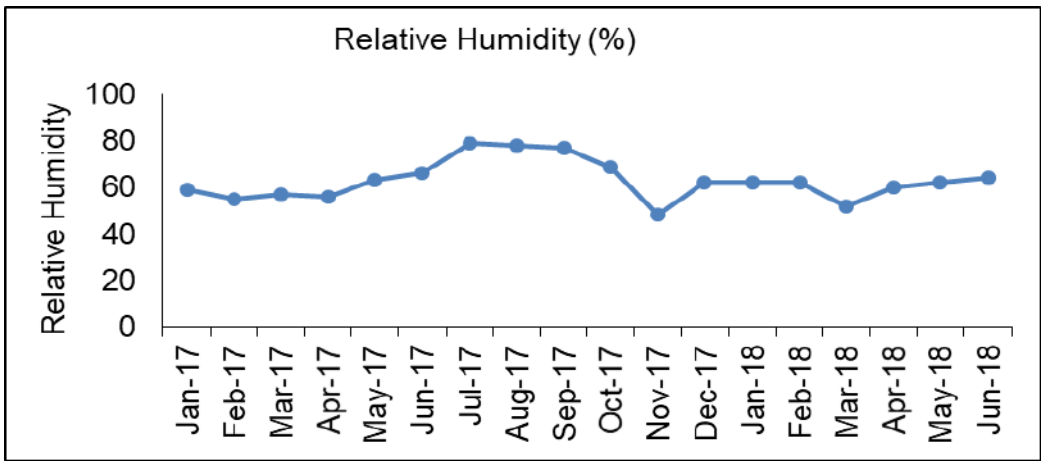


Fig. 3.1.3: Relative Humidity during January 2017 to June 2018

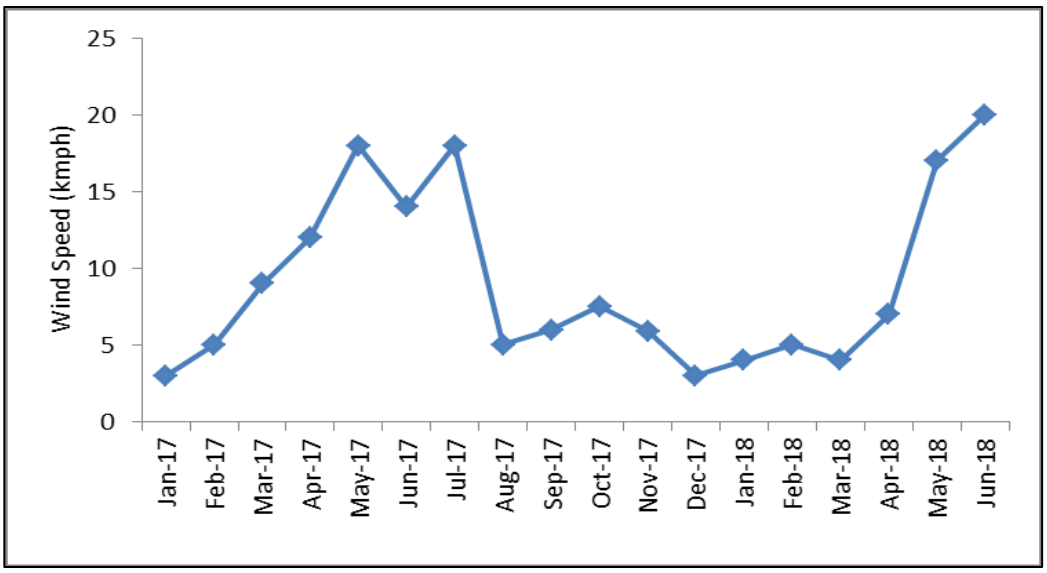


Fig. 3.1.4: Wind Speed during January 2017 to June 2018

Temperature

During January 2017 to June 2018, the monthly average temperature varied in the range of 21- 31ºC. Minimum temperature of 11ºC was recorded during January 2017, whereas maximum temperature of 42 ºC was recorded in April 2017.

Relative Humidity

Monthly average humidity was found in the range of 52-79% during 2017.

Wind Speed

Average wind speed was observed to be upto 20 km/hr, whereas maximum wind was about 52 km/hr during June 2018. Higher wind speeds were observed during summer as compared to other seasons/ months.

Windrose Diagram

Windrose diagram for Summer 2018 (April-June) has been plotted from the hourly met data collected and is shown in **Fig. 3.1.5.** This shows dominance of wind from the North direction with reasonably high wind speed (upto 5 m/s), favorable for air pollution dispersion.

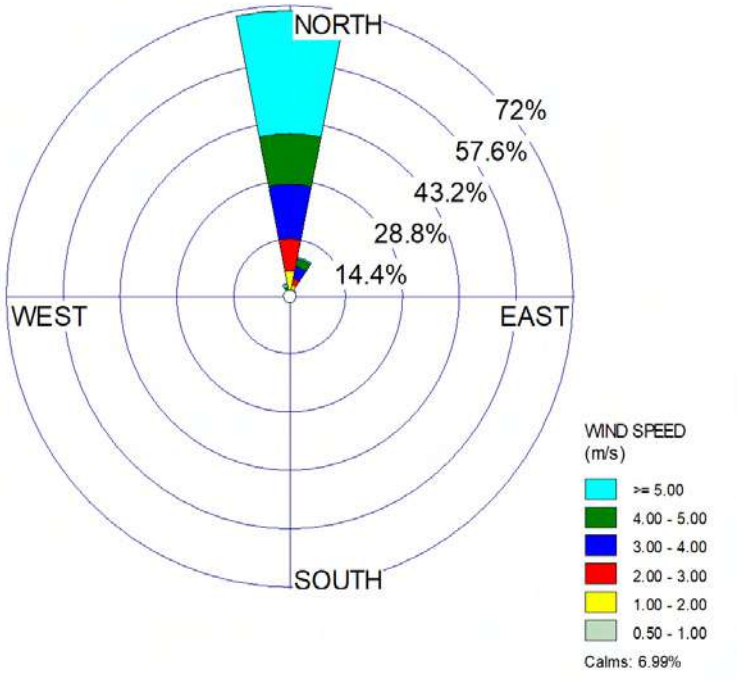


Fig. 3.1.5: Windrose Diagram during Summer 2018

This meteorological data has been used to predict the impact of refinery emissions on the ambient air quality of the region under different scenarios of expansion.

Project Site	**Refinery Township**
Vadalia Sinhan Village	**Kajurda Patiya Village**
Kajurda Village	**Zankhar Village**

Plate 3.1.1: Photographs showing Ambient Air Quality Monitoring at different Locations

Refinery Gate - 93

Refinery Main Gate

Labour Gate

Port A Camp

COT Area

Plate 3.1.2: Photographs showing Ambient Air Quality Monitoring within the Refinery Premises

Met Tower	**Met Sensors**

Plate 3.1.3: Photographs showing Meteorological Tower Installed within the Refinery Premises

Table 3.1.1: Details of Ambient Air Quality Monitoring Locations

Sr. No.	Village/ Station	Latitude	Longitude	Direction wrt Refinery	Distance (km)
1.	Refinery Complex (AQ1)	22°19'20.94"N	69°44'15.99"E	Centre	0
2.	Refinery Township (AQ2)	22°18'36.75"N	69°44'21.82"E	South	2
3.	Vadalia Sinhan (AQ3)	22°16'48.97"N	69°42'45.77"E	South	8
4.	Kajurda Patiya (AQ4)	22°17'40.59"N	69°42'40.27"E	Southwest	4
5.	Kajurda Village (AQ5)	22°20'9.57"N	69°42'3.13"E	Northwest	4
6.	Zankhar Village (AQ6)	22°21'25.11"N	69°46'7.76"E	Northeast	5
7.	Padana Village (AQ7)	22°19'50.91"N	69°50'8.72"E	West	10
8.	COT Area (AQ8)	22°23'13.06"N	69°43'7.91"E	North	1
9.	Mithoi Village (AQ9)	22°18'56.10"N	69°45'46.39"E	South	6

Table 3.1.2: Techniques Used in Ambient Air Quality Monitoring and NAAQS

Sr. No.	Parameter	Monitoring Technique	National Ambient Air Quality Standards (Duration)
1.	Particulate Matter size <10 microns or PM_{10}, µg/m^3	Gravimetric	60 (Annual) 100 (24 hours)
2.	Particulate Matter size <2.5 microns or $PM_{2.5}$, µg/m^3	Gravimetric	40 (Annual) 60 (24 hours)
3.	Sulphur Dioxide (SO_2), µg/m^3	EPA Improved West and Geake method	50 (Annual) 80 (24 hours)
4.	Oxides of Nitrogen (NO_2), µg/m^3	Modified Jacobs-Hoechheiser Method	40 (Annual) 80 (24 hours)
5.	Carbon Monoxide (CO), mg/m^3	Non Dispersive infra-red (NDIR) Spectroscopy	02 (8 hour) 04 (1 hour)
6.	Ammonia (NH_3), µg/m^3	Indophenol Blue Method	400 (24 hours)
8.	Lead (Pb), µg/m^3	AAS/ICP method for sampling on EPM 2000	0.50 (Annual) 1.0 (24 hours)
9.	Arsenic (As), ng/m^3	AAS/ICP method for sampling on EPM 2000	06 (Annual)
10.	Nickel (Ni), ng/m^3	AAS/ICP method for sampling on EPM 2000	20 (Annual)
11.	Vanadium (V), ng/m^3	-	-
12.	Benzene, µg/m^3	Gas Chromatography based continuous analyzer (BTEX)	05 (Annual)
13.	Benzo(α) Pyrene, µg/m^3	Solvent extraction followed by HPLC/GC analysis	01 (Benzo(α) pyrene)
14.	Hydrocarbon, ppm	Hydrocarbon Analyzer	-

Table 3.1.3: Air Quality Status within the Study Area: PM_{10} and $PM_{2.5}$ (Summer 2018)

Sr. No.	Location	PM_{10} (µg/m³)				$PM_{2.5}$ (µg/m³)			
		Min	Max	Avg	SD	Min	Max	Avg	SD
1.	Project Site (AQ1)	62	88	74	6.9	16	28	22	3.3
2.	Essar Township (AQ2)	78	116	92	9.0	18	37	28	5.1
3.	Vadalia Sinhan (AQ3)	62	98	83	9.3	18	33	26	4.3
4.	Kajurda Patiya (AQ4)	82	140	100	14.3	24	42	32	4.3
5.	Kajurda Village (AQ5)	60	110	85	11.6	18	38	27	5.4
6.	Zankhar Village (AQ6)	67	94	83	7.5	16	36	27	4.8
7.	Padana Village (AQ7)	71	112	89	10.2	21	36	29	4.7
8.	COT Area (AQ8)	60	118	85	14.2	15	37	27	6.1
9.	Mithoi Village (AQ9)	65	110	84	10.3	18	38	27	4.7
	NAAQS 2009	**100**				**60**			

Note: Occasional higher PM_{10} were observed due to localized activities, move of vehicles on semi-paved/kutcha roads resulting in dust re-suspension.

Table 3.1.4: Air Quality Status within the Study Area: SO_2 and NO_2 (Summer 2018)

Sr. No.	Location	SO_2 (µg/m³)				NO_2 (µg/m³)			
		Min	Max	Avg	SD	Min	Max	Avg	SD
1.	Project Site (AQ1)	14	26	20	2.9	17	32	24	3.6
2.	Essar Township (AQ2)	11	24	19	3.7	17	32	25	4.1
3.	Vadalia Sinhan (AQ3)	11	26	18	4.0	18	31	23	3.7
4.	Kajurda Patiya (AQ4)	16	31	23	3.7	19	36	29	3.9
5.	Kajurda Village (AQ5)	13	31	20	4.9	19	36	27	4.5
6.	Zankhar Village (AQ6)	10	24	17	4.0	20	30	25	3.0
7.	Padana Village (AQ7)	12	31	20	4.4	20	36	26	3.5
8.	COT Area (AQ8)	15	28	20	3.3	19	32	27	3.8
9.	Mithoi Village (AQ9)	13	24	18	2.9	19	28	24	2.5
NAAQS 2009		**80**				**80**			

Table 3.1.5: Statistical Summary of Air Quality Status within the Refinery Complex during 2017-18

Sr. No.	AQM Location/ Parameters	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)
1.	**Refinery Gate (Gate 93)**					
	Minimum	68	16	16	19	<1
	Maximum	94	44	39	42	<1
	Average	**85**	**29**	**23**	**27**	**<1**
	98^{th} percentile	**94**	**43**	**37**	**40**	<1
2.	**Refinery Main Gate**					
	Minimum	64	18	17	18	<1
	Maximum	94	34	32	37	<1
	Average	**79**	**26**	**23**	**26**	**<1**
	98^{th} percentile	**93**	**31**	**31**	**36**	<1
3.	**Labour Gate**					
	Minimum	65	18	14	18	<1
	Maximum	96	44	34	37	<1
	Average	**85**	**30**	**22**	**26**	**<1**
	98^{th} percentile	**95**	**43**	**33**	**36**	<1
4.	**Port A Camp**					
	Minimum	66	21	16	21	<1
	Maximum	94	33	37	42	<1
	Average	**83**	**27**	**23**	**27**	**<1**
	98^{th} percentile	**93**	**33**	**35**	**40**	<1
5.	**COT Area**					
	Minimum	62	15	13	16	<1
	Maximum	89	32	30	31	<1
	Average	**77**	**24**	**21**	**24**	**<1**
	98^{th} percentile	**88**	**31**	**29**	**31**	<1
	NAAQS (Annual Average)	**60**	**40**	**50**	**40**	**2.0**

Table 3.1.6: Monthly Variation in Meteorological Data from January 2017 to June 2018

Month	Temperature (ºC)			Humidity (%)			Wind Speed (km/h)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Jan-17	21	11	31	59	18	96	3	0	22
Feb-17	23	11	37	55	11	95	5	0	25
Mar-17	26	14	36	57	12	94	9	0	26
Apr-17	30	19	42	56	6	93	12	0	33
May-17	32	26	40	63	20	90	18	1	51
Jun-17	32	25	40	66	37	96	14	0	39
Jul-17	29	25	34	79	56	94	18	0	41
Aug-17	29	25	33	78	54	97	5	0	32
Sept-17	29	24	33	77	50	94	6	0	28
Oct-17	29	22	38	69	21	95	8	0	22
Nov-17	27	19	34	48	17	87	6	0	18
Dec-17	22	12	31	62	22	96	3	0	15
Jan-18	21	11	32	62	19	96	4	0	14
Feb-18	24	14	36	62	18	96	5	0	16
Mar-18	29	22	37	52	8	94	4	0	15
Apr-18	30	20	39	60	8	96	7	0	33
May-18	31	26	41	62	11	93	17	0	53
Jun-18	31	27	37	64	39	85	20	1	52

Source: Data collected by refinery.

3.2 Noise Environment

Noise problem is said to exist when the sound level in the air causes interference in human activities such as disturbance in sleep, work and speech communication leading to annoyance. Perception of noise by individuals varies depending on number of factors such as natural sensitivity/hearing ability, level of exposure, time of the day, socio-cultural activities etc. at the time of exposure to sound. The impact of noise at community level can have different effects varying from aesthetic impairment such as annoyance, frequent hypertension to as high as loss of hearing. The health impact of noise on individual depends on several factors, viz., physical dose (intensity of sound pressure level and duration of exposure), frequency spectrum, intermittency etc., as well as human factors like sex, age, health condition, occupational exposure etc.

Assessment of noise impacts and the significance of any impact as a result of development are dependent upon the number of factors such as the ambient or background noise levels in the vicinity of the site, the type of development and its operating characteristics. Therefore noise monitoring was carried out to identify and quantify so far as reasonably possible the ambient condition to predict the increase in noise levels and causes of variability of noise levels as a result of the proposed development.

3.2.1 Noise Monitoring Locations and Methodology

Noise monitoring was carried out in residential areas of different villages, near noise sources within the existing plant and along its boundary, and near the heavy traffic zones (SH-25) within 10 km radius area. Sound pressure levels were measured as 'A' weighted average in the identified locations by using integrated digital sound level meter Cirrus CR: 172B having mounted on tripods at the height of approximate 1.3-1.5 m above the ground level in a free field location.

The noise meter was placed at least 3-4 m away from the reflective surfaces on all sides to avoid capturing reflected sound. The measurements at each identified location were averaged over the 20-minutes measurement period using the equivalent noise levels Leq dB(A) setting, which is similar to the response of the human ear at the lower level.

Equivalent noise levels (Leq) were recorded at each monitoring location during day time. Noise monitoring locations in residential area are shown in **Fig. 3.2.1**. The noise monitoring was done at 12 residential locations/villages, 11 locations within and around the refinery complex and at highway near refinery gate during morning,

afternoon, evening and night hours. Photographs showing noise monitoring at different representative locations are given in **Plates 3.2.1** and **3.2.2**.

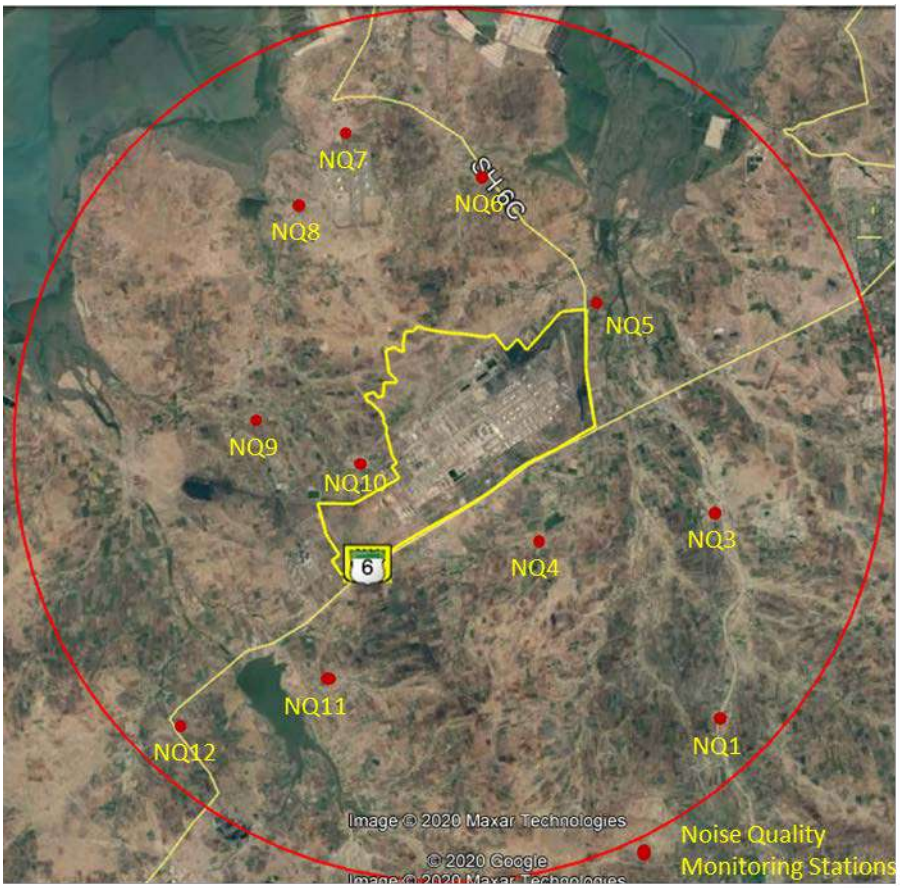


Fig. 3.2.1: Noise Monitoring Locations in Different Villages

3.2.2 Measured Noise Levels

Details of noise monitoring locations along with recorded noise levels are given in **Tables 3.2.1**, **3.2.2** and **3.2.3,** respectively for residential areas, in & around refinery complex and near the traffic corridor close to the refinery gate. CPCB standards for ambient noise level are given in **Table 3.2.4.**

Noise Levels in Residential Area

Noise levels (Leq) measured in 12 different residential areas/ villages varied from 42-53 dB(A) during day time and 29-37 dB(A) during night time. The CPCB standard for day time and night time average noise level is 55 dB(A) and 45 dB(A), respectively. The field observations during the study period indicate that the ambient

noise levels at residential sites were well within the prescribed standards of CPCB. In rural areas, wind blowing and chirping of birds would contribute to noise levels especially during the daytime.

Noise Levels in and around Refinery Complex

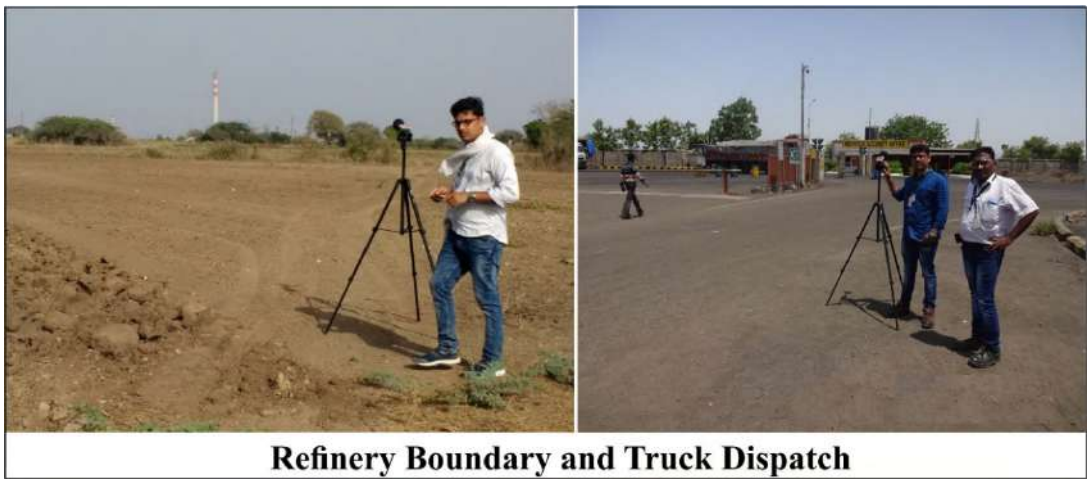
Noise levels (Leq) at the proposed project site varied between 43-46 dB(A). Low noise levels were expected, as presently the area is remote and free from any activities. Noise levels varied from 56-67 dB(A) at various locations inside the existing refinery, whereas near the boundary wall (in different directions), levels were in the range of 50-67 dB(A), highest being at the refinery main gate.

Noise Levels due to Vehicular Movements

State highway SH-25 passes near the existing refinery. To determine the impact of highway traffic noise on the study area typically 60 minutes average equivalent noise level (LAeq) at the monitoring location is taken. Noise levels were measured along with the traffic volume during morning, afternoon, evening and night hours. Noise level of 74 dB(A) with a maximum traffic volume of 1452 was observed during morning hours at highway SH-25. Whereas, during night-time, the volume of light, medium and heavy vehicles was much less as compared to other hours which is the main cause of drop of the sound pressure levels of highway traffic noise. The computed average day-night sound pressure levels (Ldn) for 24 hours was 66 dB(A) and noise level in the morning, afternoon, evening and night hours were observed between 67-74 dB(A). High levels of noise were attributed to the movement of vehicles along with intermittent honking by the vehicles.

Residential Area

Proposed Site Area



Refinery Boundary and Truck Dispatch

Plate 3.2.1: Photographs showing Noise Monitoring in Different Villages, Proposed Project Site and in the Existing Refinery Complex

Plate 3.2.2: Noise Monitoring within the Existing Refinery Premises

Table 3.2.1: Noise Monitoring Locations with Measured Noise Levels in Different Villages/ Residential Area

Sr. No.	Location/ Village	Sampling Location Coordinates		Noise Levels LAeq, dB(A) (Daytime)	Noise Levels LAeq, dB(A) (Nighttime)
		Latitude	Longitude		
1.	Modpar	22° 16' 05.59" N	69° 48' 07.32" E	53	37
2.	Rasangpar	22° 17' 56.56" N	69° 47' 08.97" E	46	32
3.	Lakhiya Nana	22° 19' 07.29" N	69° 47' 54.42" E	42	29
4.	Mithoi	22° 19' 01.94" N	69° 46' 05.34" E	42	29
5.	Zankhar	22° 21' 34.61" N	69° 46' 10.87" E	46	31
6.	Singach	22° 23' 14.44" N	69° 44' 39.37" E	46	32
7.	Vadinar	22° 23' 45.71" N	69° 43' 06.49" E	48	34
8.	Bharana	22° 22' 32.70" N	69° 42' 24.69" E	52	36
9.	Timbdi	22° 20' 06.35" N	69° 42' 00.02" E	51	36
10.	Kajurda	22° 19' 29.24" N	69° 43' 27.01" E	48	34
11.	Vadaliya Sinhan	22° 16' 41.66" N	69° 42' 46.99" E	53	36
12.	Danta	22° 16' 40.73" N	69° 40' 37.68" E	52	36
	CPCB Limits, dB(A)			**55**	45

Table 3.2.2: Noise Levels Measured in and around the Refinery Premises

Sr. No.	Location/ Village	Sampling Location Coordinates		Noise Levels LAeq, dB(A)
		Latitude	Longitude	
	Proposed Area			
1.	Proposed Site	22° 18' 28.37" N	69° 43' 41.77" E	43
2.	Proposed Site Boundary	22° 18' 24.22" N	69° 43' 46.53" E	46
	Inside Refinery			
1.	Overall Refinery	-	-	58 - 67
2.	Truck Dispatch Area	22° 21' 16.79" N	69° 46' 11.72" E	66
	Outside Refinery			
1.	Main Gate (SH-25)	22° 19' 14.94" N	69° 45' 17.78" E	67
2.	Refinery boundary Wall (SH-25)	22° 19' 36.10" N	69° 45' 56.23" E	63
3.	Refinery boundary Wall (Zankhar)	22° 20' 04.49" N	69° 46' 24.52" E	50
4.	Material Gate NE Wall	22° 21' 16.66" N	69° 46' 22.08" E	65

5.	Between Refinery & Petrochemical Wall	22° 18' 43.43" N	69° 44' 12.81" E	52
6.	Labour Colony Wall	22° 19' 01.44" N	69° 44' 00.35" E	56
7.	Petrochemical Boundary Wall	22° 18' 00.74" N	69° 43' 14.32" E	50
	CPCB Limits, dB(A)			**75**

Table 3.2.3: Traffic Noise Levels and Traffic Volumes at Highway near the Refinery

Sr. No.	Monitoring Time (hours)	Sampling Location Coordinates	No. of Vehicles			Noise Levels LAeq dB(A)	Ldn dB(A)
			Heavy	Medium	Light		
1.	Morning	22° 19' 14.94" N / 69° 45' 17.78" E	200	241	1011	74	65.9
2.	Afternoon		112	88	467	67	
3.	Evening		181	158	1184	72	
4.	Night		101	57	258	67	

Table 3.2.4: Ambient Noise Standards (CPCB)

Area Code	Category of Area/Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Notes:

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is defined as an area comprising not less than 100 meters around Hospitals, Educational Institutions and courts. The silence zones are zones which are declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four abovementioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is related to human hearing

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of human ear

Leq : It is an energy mean of the noise level over a specified period.

3.3 Water Environment

3.3.1 Water Sampling Locations and Assessment Methodology

The baseline water quality status in the region was established by analysing samples from ground water (7 dug wells) and surface water (Phuljhar River and Sinhan dam) sources within 10 km radius from the refinery. Besides, one sea water sample was taken from Vadinar jetty, which is about 12 km from the refinery. Also one sample was taken from the tanker, which supplies water to nearby water-scarce villages. Samples were also taken from the inlet and outlet of the Effluent Treatment Plant of the refinery. Details of sampling locations are given in **Table 3.3.1**, and are shown in **Fig 3.3.1**. Photographs showing water sampling at different locations/sources are shown in **Plate 3.3.1**.

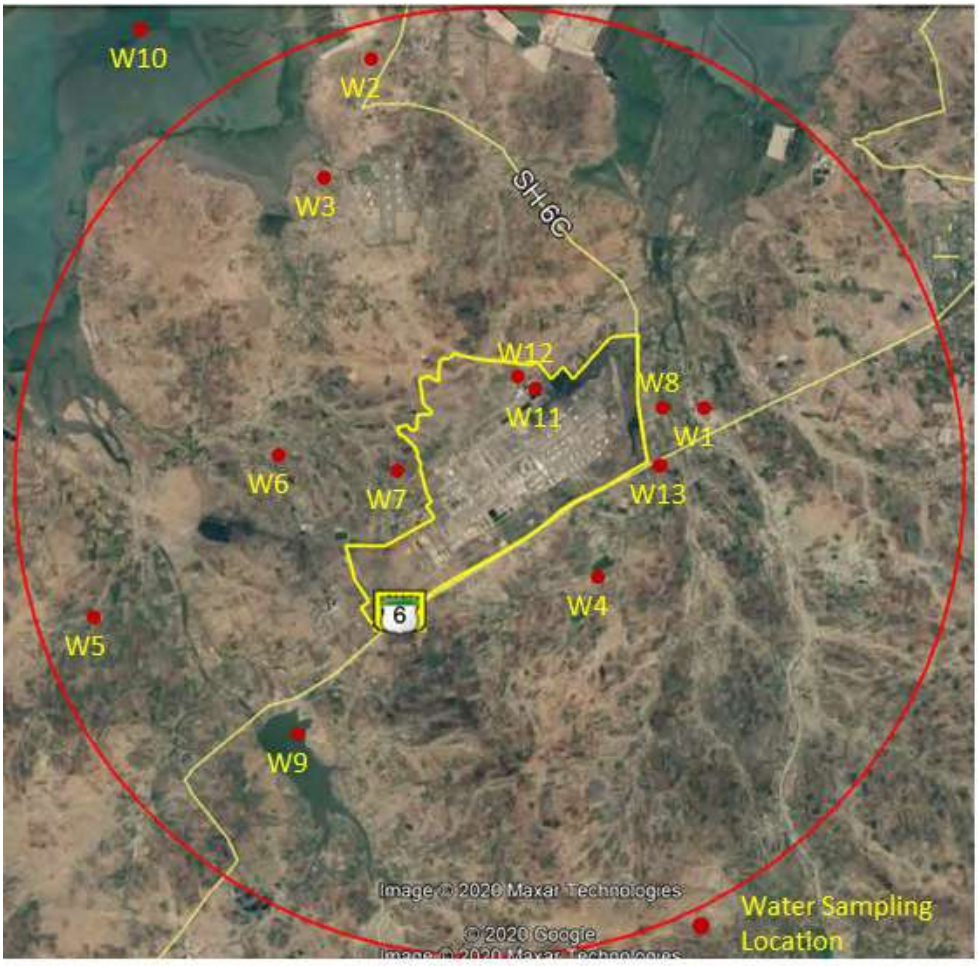


Fig. 3.3.1: Water Sampling Locations

The samples for physico-chemical analysis were collected in polypropylene bottles. Samples for heavy metal were collected in amber (brown) bottles and were

acidified with concentrated HNO_3 to pH <2. Samples for bacteriological analysis were collected in sterilized bottles. Selected physico-chemical and bacteriological parameters were analysed for assessing the existing water quality status in the study area. The analysis protocol was followed as per the procedures specified in 'Standard Method for the Examination of Water and Wastewater' published by American Public Health Association (APHA. 23rd Edition 2017).

3.3.2 Water Quality Status

Water quality status in terms of various physico-chemical parameters, heavy metals and bacteriological parameters have been assessed for various water sources. The results are presented in **Tables 3.3.2 to 3.3.9** respectively for ground water, surface water, sea water sources, Refinery ETP and tanker water supply.

3.3.2.1 Ground Water Quality Characteristics

Ground water samples from all 7 locations were collected from dug wells in and around the refinery area and analysed to assess the water quality. The physical parameters analysed were found in the range as: pH- 7.0-7.7 and turbidity values were less than 1 NTU at all the sampling sites, except at Vadinar dug well (2.6). TDS values ranged from 292-3372 mg/l showing minimum value in Vadinar and maximum value in Mithoi Village.

Inorganic parameters were found in the range as; Chlorides: 27-1400 mg/l; Sulphates: 7-191 mg/l; Total alkalinity: 256-370 mg/l and Total hardness: 168-2060 mg/l. Mithoi village sample showed maximum value for total hardness (2060 mg/l), calcium hardness (370 mg/l) and chlorides (1400 mg/l). Sulphate was found maximum in Zankhar village (191 mg/l), whereas minimum in Vadinar village sample.

Nutrients as nitrate and total phosphates were observed in the range of 0.2-15 mg/l and 0.1-1.1 mg/l respectively. Highest Nitrate concentration was found in Mota Manda village. Fluoride was found to be in range of 0.3-1.1 mg/l. Since the dug wells were found to contain plant debris, it became necessary to determine its BOD to know the level of biological contamination. BOD ranged from 2-12 mg/l. Maximum BOD was found in Refinery dug well water (12 mg/l), followed by sample of Bharana village (11 mg/l).

Total coliforms and faecal coliforms were found in all the samples that ranged between 5×10^3-14×10^5 CFU/100 ml and 42-1240 CFU/100 ml respectively. Maximum number of total coliforms was found in a dug well inside the refinery whereas minimum counts were found in Mithoi i.e. $16X10^4$ CFU/100. Similarly faecal coliform was found maximum in Zankhar village (1240 CFU/100) and minimum value at Vadinar (42 CFU/100 ml).

It is to be noted that due to many parameters exceeding the limits of drinking water quality, however the water of dug wells is mainly used for non-potable purposes, like irrigation, bathing of cattle's, floor cleaning etc.

3.3.2.2 Surface Water Quality Characteristics

Zankhar Phuljhar River

Physico-chemical parameters of Phuljhar River showed water quality in terms of various parameters as turbidity of 0.65 NTU and total suspended solids as 35 mg/l. Buffering capacity in terms of alkalinity was found to be 144 mg/l, whereas pH was 6.7. Chlorides were found as 1600 mg/l. Nutrient load in terms of Nitrates (as NO_3) was 4.1 mg/l, whereas total phosphates were 0.17 mg/l. Fluoride was found to be 0.9 mg/l; whereas oil and grease was reported as 0.05 mg/l. The oxygen demand parameter determined in terms of BOD was 10 mg/l.

During Bacteriological study, total coliform and faecal coliforms have also been detected as 5×10^3 CFU/100 ml and 520 CFU/100 ml respectively.

Phuljhar river is not a perennial river. Sample was collected from the accumulated water in the path of river. Some of the water quality parameter like TDS, conductivity, chlorides, sulphates and sodium were found on higher side.

Sinhan Dam

Various water quality parameters of Sinhan Dam were determined as: pH- 7.2, turbidity- 2.5 NTU, total dissolved solids - 269 mg/l, chlorides - 104 mg/l and sulphates - 43 mg/l. Nutrients in terms of nitrates (as N) and total phosphate were found to be 0.5 mg/l and 0.1 mg/l respectively. BOD was 2 mg/l and fluoride was 0.8 mg/l.

Total coliforms (52×10^2 CFU/100 ml) and Faecal coliform (50 CFU/100 ml) were also found in Sinhan dam water. As per CPCB classification for inland surface water, this surface water body could be classified under Class B, i.e. Outdoor bathing (Organised).

3.3.2.3 Sea Water Quality Characteristics

Sea water collected from Vadinar Jetty showed water quality characteristics as: pH - 7.4), Turbidity - 0.46 NTU and Total Suspended Solid - 23 mg/l, TDS - 38729 mg/l and EC - 86000 µS/cm. Similarly, inorganic parameters were found to have very high values viz.; Total alkalinity - 176 mg/l, Total hardness - 3090 mg/l, chlorides - 25000 mg/l, sulphates - 3371 mg/l and sodium - 10854 mg/l. COD was 1010 mg/l.

Total coliforms and Faecal coliforms (FC) were also found in sea water sample as 1620 CFU/100 ml and 130 CFU/100 ml respectively.

3.3.2.4 Water Quality Characteristics of Refinery ETP

Samples from inlet and outlet of Effluent Treatment Plant of refinery were collected. The analysis results are presented in **Table 3.3.5**. Perusal of results indicate substantial reduction in turbidity (from 74 NTU to 1.2 NTU), total hardness (from 260 mg/l to 46 mg/l), BOD (from 19 mg/l to 1.6 mg/l) and COD (from 301 mg/l to 12 mg/l). Total coliforms also reduced from $82x10^4$ to 900 CFU/100 ml, whereas FC was not detected in either of the samples.

3.3.2.5 Drinking Water Supplied by Tankers

One sample was collected form the tanker used for supply of water from refinery to the nearby villages. The characteristics of drinking water supplied are given in **Table 3.3.6.** Perusal of results indicates that all the parameters were well within the acceptable/ permissible quality of drinking water, except for bacteriological parameters. Total coliforms were found significantly at 106 x 10^3, with some traces of faecal coliforms. The tanker needs to be properly disinfected and also quality of water sourced should be checked particularly for bacteriological parameters, and accordingly disinfection should be done.

3.3.2.6 Heavy Metal Content

Heavy metal content was determined in all the water samples collected, with respect to lead, cadmium, copper, cobalt, manganese, iron, zinc, chromium and nickel. All the metals were found below detectable limit except chromium, manganese, iron and copper. Sample-wise metal content is given in **Table 3.3.7**. All the metals were found within the limits, except for chromium in water supplied by the tanker.

3.3.3 Biological Environment

Biological indicators of surface and ground water quality in terms of Phytoplankton, Zooplankton and Shannon Wiener Diversity Index (SWDI) were also assessed.

3.3.3.1 Assessment Methodology

Phytoplankton Analysis

The Lackey Drop (Micro transect) Count Method (Lackey, 1938; Edmonson, 1963) is a simple method for obtaining counts of phytoplankton with considerable accuracy. Organisms were counted under microscope in strips on slide from a drop of centrifuged, decanted and concentrated volume of sample and number of individuals of each organism was counted in 40x magnification. Phytoplankton count (Sp. /ml) is determined as:

Phytoplankton count = (C × D)/ V

Where,

C = Total number of counted individuals of species in a sample

D = is number of drops added for making up for 1 ml in a pipette (number can vary according to type of pipette used)

V = is the volume of water used for centrifugation (ml)

Zooplankton Analysis

Zooplankton density is always lesser than phytoplankton density; therefore around 20-50 L of water is passed through plankton net (mesh size 50 µm) to

concentrate zooplankton. The entire water is centrifuged, decanted and concentrated to make 2 ml volume for observation in S-R (Sedgwick-Rafter) counting cell. The zooplankton is counted in 10x magnification.

Zooplankton count (No. /m^3) is determined as:

Zooplankton count = C × (V1/ V2) × V3

Where,

C = Total number of counted individuals of species in a sample

V1 = Volume of concentrated sample through plankton net (ml)

V2 = Centrifuged, decanted and contrasted volume of sample in ml i.e. 15 mL

V3 = Volume of grab sample (m^3)

SWDI Calculation

For studying community structure, the species are grouped in taxonomic classes and percentages of groups are calculated from total counts of sample. The diversity is calculated for each community by Shannon Wiener Diversity Index (SWDI) as:

nSWDI = -∑ (ni/N).log2 (ni/N)

Where,

n = Number of species

N = Total number of individuals of all species

Ni = Number of individuals of "i"th species

Where proportion is obtained by dividing the number of individuals of a species by total number of individuals of all species for which log2 proportion is obtained by Index table (Shannon, 1968).

3.3.3.2 Status of Biological Parameters

Phytoplankton

Samples were collected from the surface water (including sea water) and from dug wells using a clean polythene bucket for analysis of phytoplankton. Samples were fixed in Lugol's iodine solution and preserved in 2% formalin. The results of number of phytoplankton along with SWDI and species identified are given in **Tables 3.3.8** and **3.3.9** respectively.

A total of 29 species from 7 families were found in the samples. The overall communities of the Phytoplankton's were represented mainly by seven groups with their genera are as: Chlorophyceae (20), Bacilleriophyceae (3), Chrysophyceae (2), Euglenophyceae (1), Gymnodiniaceace (1), Cynophycaceae (1) and Peridiniaceae (1).

Twenty different species of Chlorophyceae belonging to different genera (Anabena, Botryococuss, Chaetomorpha, Chlorella, Chlorococcus, Chodatella, Diacanthos, Draparnalda, Enteromorpha, Gomphosphaeria, Microspora, Nostoc, Oedogonium, Oocystis, Phytoconis, Planktosphaeria, Spirulina, Stichococcus, Ulothrix and Volvox) were found, contributing 69% of the total plankton population in the overall water samples. The second most abundant group was found to be of family Bacilleriophyceae. Three different species of the family Bacilleriophyceae that belong to three different genera (Nitzschia, Navicula and Cymbella) were found in the water bodies which contributed 10% of the total plankton community.

The family Chrysophyceae accounted for 7% of the total group in which species like Cosmarium and Mougeotia were found. Only one species i.e. Eutreptia representing the family Euglepophyceae, Amphidinum representing the family Gymnodiniaceace, Lyngbya representing the family Cynophycaceae and Peridinium representing the family Peridiniaceae was found accounting, 3% each of these groups of the total planktons were observed **(Fig. 3.3.2)**

Shannon Weiner Diversity index was found to be less than 1 only at one location (i.e. Vadinar Village) that shows less species diversity while at other sampling locations, it was found to be between 1.0 to 1.8 showing more species diversity except at three locations (Zankhar village, Kajurda village and refinery dug well samples), where it was 2 and more than 2 representing maximum species diversity.

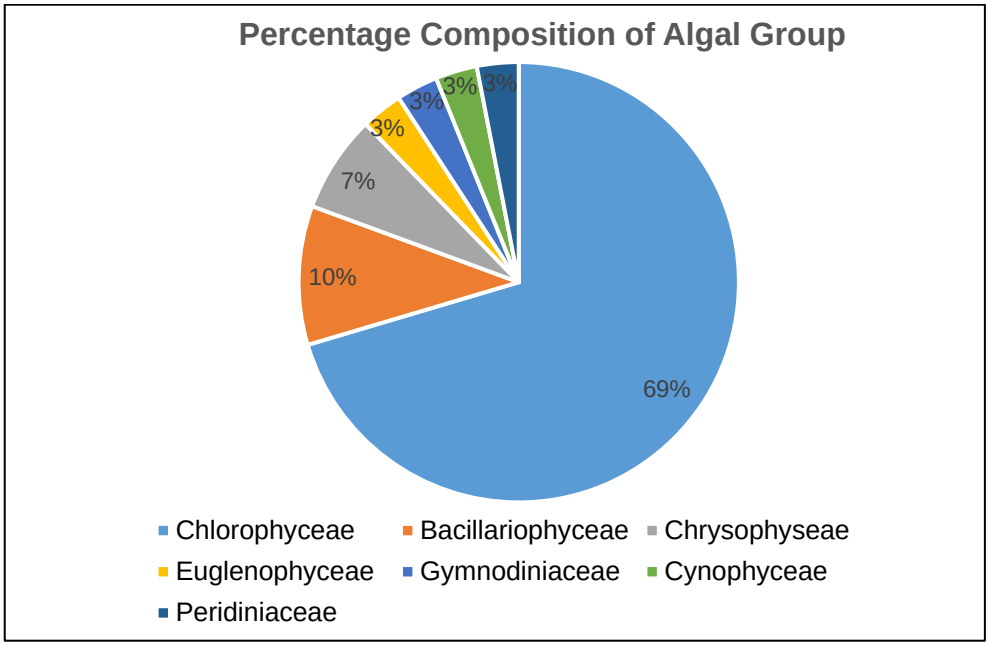


Fig. 3.3.2: Distribution of Groups of Phytoplankton in Water Samples

Zooplankton

Status of zooplanktons in surface water (including sea water) and ground water samples is given along with SWDI in **Table 3.3.10**. Less population density was observed in the study area with the predominance of Rotifera, Cladosera, and Copepoda. The rotifer group was the most abundant group showing 53% of the Zooplanktons community. Other groups like Cladosera - 27%, Copepoda - 20% were found during the study period **(Fig. 3.3.3)**.

Shannon Weiner Diversity Index was found to be less than 1 at four locations showing less species diversity while it was >1 at the remaining locations with maximum SWDI value of 1.5 (Vadinar Village) showing species richness in comparison to other locations.

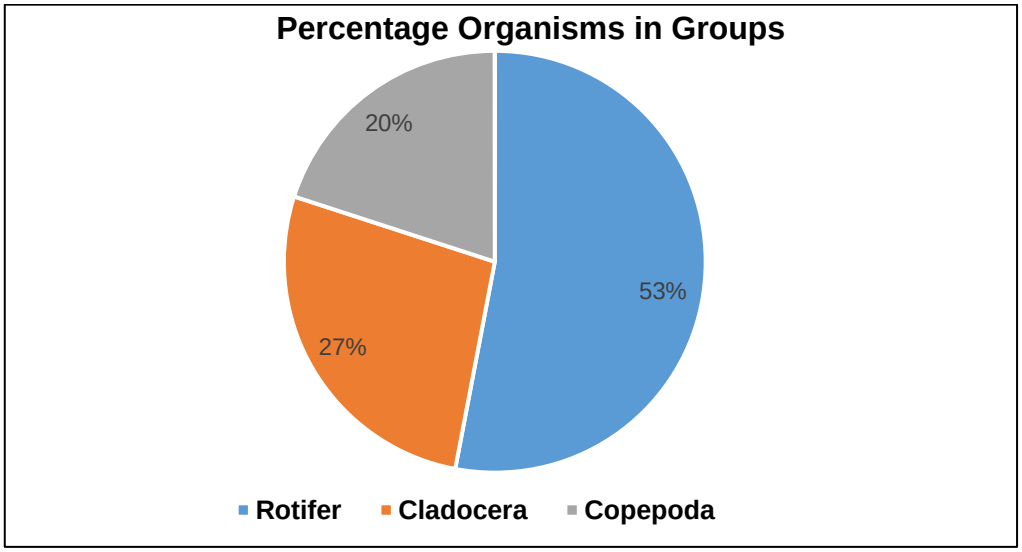


Fig. 3.3.3: Distribution of Groups of Zooplankton in Water Samples

3.3.4 Geology and Hydrogeology

The details of geology and hydrogeology taken from the recent studies conducted in the region for M/s Nayara Energy (ESSAR Oil) Limited are briefly summarized here.

3.3.4.1 Methodology

Physiographic Studies: On the basis of regional levels marked with the help of spot level shown in SOI toposheet, latest google image, site visit and GPS readings, general physiographic conditions were studied in core and buffer zone.

Hydrogeological observations: In hydrogeological studies, observations were made about geology and types of aquifers, surface drainage pattern, water quality, water levels etc. through hydrogeological inventory of existing groundwater structures in core as well as buffer zone.

Hydro-chemical Study: In this study, representative samples were analyzed for key quality parameters and effects on groundwater quality is studied.

Geoelectric Survey: Geoelectric survey was done on representative sites in buffer zone to know about the behavior of subsurface deposition of aquifer system and water quality. The interpretation of geoelectric data depicting lithology, water level saturation and expected quality of ground water was included.

Pumping Test: In this test, pump in existing tube well was run at constant discharge and drawdown of water table was recorded at periodic intervals for minimum of two log cycles. These data helped to know approximate transmissivity and specific yield of the aquifer, which were in-tern used to know hydraulics of ground water regime in a given area.

3.3.4.2 Hydrogeological Status of Buffer Zone of 10 km Radius Area

Physiography & Vegetation

The physiography of the buffer area comprises of undulating buried Pedi plain of denotational origin. Based on spot levels obtained from google image and GPS data recorded in the field, the localized physiographic gradient was determined which is in general towards north, northeast and north-west, with elevation ranging from 10 m to 50 m from mean sea level. The average ground elevation within the buffer area is 30 m from mean sea level. The vegetation is sparse with deep-rooted trees at number of places.

Generalized Geology of the Area

The geology of the buffer area is mainly composed of thin alluvial cover, belonging to Sub-Recent to Recent period of Quaternary Period followed by basalts of Upper Cretaceous to Lower Eocene age. The general regional geology of the study area as per Geological Survey of India, is given below as:

Geological Succession of the Region

Era	Age	Formation	Lithology
Quaternary	Holocene	Recent	Costal mud, sand and salt
	Sub-Recent to Pleistocene	Porbander beds	Miliolite Limestone
Cainozoic to Mesozoic	Upper Cretaceous to Lower Eocene	Deccan traps & Intertrappean	Picrite/Tholeitic basalt flows

3.3.4.3 Surface Water, Drainage and Rainfall

The buffer area falls in Sinhan river basin & forms the part of catchment area of Phuljhar River which is not perennial in nature and remains dry for most part of the year, except during monsoon season. There is well-developed drainage, which is dendritic to sub parallel in nature with low gradients. However, some ponds exist in the course of river within 10 km periphery of the Refinery.

Rainfall plays a major role in groundwater availability of semi-humid region like Vadinar as it is important source for groundwater recharge. Rainfall record of nearest rain gauge at Khambalia tehsil headquarter shows that average annual rainfall of last 35 years (1982-2017) is around 603 mm (Source: Director of Relief, Revenue Department, Gandhinagar). 80% of annual rainfall occurs during monsoon months (June to September). The average annual rainfall of last 10 years for Jamnagar is 648 mm & rainfall pattern as per IMD is given in table below as:

Rainfall Pattern at Rain gauge Station

Years →	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	**Average**
Rainfall (mm)	367	542	1374	444	432	934	546	450	728	663	**648**

3.3.4.4 Aquifer Types

The basalt is main aquifer zone and ground water generally occurs in un-confining conditions and is transmitted through the fractures & vesicles. Basalts are impervious in nature and have developed secondary porosity or fracture porosity. The secondary porosity decreases with depth due to overlying weight of the rocks which reduces the secondary openings.

3.3.4.5 Water Level and Seasonal Fluctuation

In post monsoon of 2012, water level varied between 4.56 m to 15.24 m below ground level in buffer zone. Average seasonal fluctuation in the study area has been around 4 m in last 5 years. During December 2017, the water level in the area ranges between 2.47 m to 13.63 m below ground level. The water levels in 2017 have improved in general in whole of buffer area by about 2 m as compared to 2012. This is probably due to better rainfall in preceding year 2016 as compared to 2012.

1. Vadinar Jetty
2. Mota Manda Village
3. Sinhan Dam Reservoir
4. Bharana Village
5. Phuljhar River
6. Zankhar Village
7. Vadinar Village
8. Khajurda Village

Plate 3.3.1: Photographs showing Water Sample Collection from Different Sources

Table 3.3.1: Details of Water Quality Sampling Locations (Summer 2018)

Sr. No.	Sampling Site/ Village	Source	Latitude	Longitude
Ground Water Sources (Dug Wells)				
1.	Zankhar (W1)	Dug Well	22°20'36.08"N	69°47'10.03"E
2.	Vadinar (W2)	Dug Well	22°24'20.45"N	69°43'14.87"E
3.	Bharana (W3)	Dug Well	22°23'08.77"N	69°42'42.07"E
4.	Mithoi (W4)	Dug Well	22°18'55.18"N	69°45'43.75"E
5.	Mota Manda (W5)	Dug Well	22°18'20.48"N	69°40'00.95"E
6.	Kajurda (W6)	Dug Well	22°19'45.09"N	69°41'51.75"E
7.	Refinery Complex (W7)	Dug Well	22°19'58.69"N	69°44'09.89"E
Surface Water Sources				
8.	Phuljhar River (W8)	Surface	22°20'36.08"N	69°47'10.03"E
9.	Sinhan Dam (W9)	Surface	22°17'01.43"N	69°42'10.01"E
Sea Water				
10.	Vadinar Jetty (W10)	Sea	22°26'55.77"N	69° 40'10.80"E
Refinery ETP Water				
11.	ETP Inlet (W11)	ETP	22°20'41.99"N	69°45'19.32"E
12.	ETP Outlet (W12)	ETP	22°20'49.72"N	69° 45'07.26"E
Supplied Drinking Water				
13.	Water supplied to Villages by Tanker (W13)	Narmada River	22°19' 52.14"N	69°46'27.04"E

Table 3.3.2: Water Quality Characteristics of Ground Water Sources (Dug Wells)

Sr. No.	Parameters	Units	Acceptable/ Permissible Limit (IS 10500: 2012)	Zankhar Village	Vadinar Village	Bharana Village	Mithoi Village	Mota Manda Village	Kajurda Village	Refinery Complex
A.	**Physical Parameters**									
1.	pH		6.5 – 8.5/ No relaxation	7.3	7.0	7.1	7	7.4	7.7	7.4
2.	Temperature	(^{0}C)	-	27	27	27	27	27	27	28
3.	Turbidity	(NTU)	1 /5	0.8	2.6	0.4	0.5	0.4	0.2	0.5
4.	TSS	(mg/l)	-	13	33	59	19	2	7	16
5.	TDS	(mg/l)	500/2000	2649	292	1765	3372	1376	1198	748
6.	Conductivity	(µS/ cm)	-	4200	432	3000	15400	2600	2400	1400
B.	**Inorganic Parameters**									
7.	Total Alkalinity (as $CaCO_3$)	mg/l	200/600	282	264	360	274	256	370	320
8.	Total Hardness (as $CaCO_3$)	mg/l	200/600	1100	168	880	2060	600	204	760
9.	Calcium Hardness (as $CaCO_3$)	mg/l	-	110	52	26	370	34	40	44
10.	Chlorides	mg/l	250/1000	1020	27	690	1400	520	590	380
11.	Sulphates	mg/l	200/400	191	7	91	179	124	157	44
12.	Sodium	mg/l	-	73	28	275	352	363	358	74
13.	Potassium	mg/l	-	1.3	4.1	0.8	0.1	1.2	1.1	0.3
C.	**Nutrient and Demand Parameters**									
14.	Nitrate as NO_3	mg/l	45 / No relaxation	13.4	0.4	0.2	4.0	15.3	13.6	5.8
15.	Total Phosphates	mg/l	-	0.2	1.1	0.2	0.1	0.3	0.2	0.2
16.	Fluoride	mg/l	1.0/1.5	0.7	0.3	0.5	0.9	1	1.1	0.9
17.	Oil & Grease	mg/l	-	-	0	0	-	-	-	0.1
18.	BOD	mg/l	-	4.4	7.2	11.2	4.2	2.9	2.2	12
19.	COD	mg/l	-	-	-	95	-	-	-	-
D.	**Bacteriological Parameters**									
20.	Total Coliforms	CFU/ 100 ml	Nil	64×10^3	52×10^4	4×10^5	16×10^4	92×10^2	124×10^2	14×10^5
21.	Faecal Coliforms	CFU/ 100 ml	Nil	1240	42	56	760	62	580	1200

BDL: Below Detectable Limit; CFU: Colony Forming Unit

Note: As informed by the villagers, the water of dug wells is mainly used for non-potable purposes like irrigation, cattle bathing etc.

Table 3.3.3: Water Quality Characteristics of Surface Water Sources

Sr. No.	Parameters	Units	Phuljhar River*	Sinhan Dam
A.	**Physical Parameters**			
1.	pH		6.7	7.2
2.	Temperature	(^{0}C)	30	27
3.	Turbidity	(NTU)	0.65	2.5
4.	Total suspended solids	(mg/l)	35	35
5.	Total Dissolved Solids	(mg/l)	3767	269
6.	Conductivity	(µS/cm)	6200	347
B.	**Inorganic Parameters**			
7.	Total Alkalinity (as $CaCO_3$)	mg/l	144	162
8.	Total Hardness (as $CaCO_3$)	mg/l	1000	128
9.	Calcium Hardness (as $CaCO_3$)	mg/l	80	30
10.	Chloride	mg/l	1600	104
11.	Sulphate	mg/l	176	43
12.	Sodium	mg/l	393	64
13.	Potassium	mg/l	4.2	3.1
C.	**Nutrient and Demand Parameters**			
14.	Nitrate as NO_3	mg/l	4.1	0.5
15.	Total Phosphates	mg/l	0.2	0.1
16.	Fluoride	mg/l	0.9	0.8
17.	Oil & Grease	mg/l	0.1	0.1
18.	BOD	mg/l	10	2.2
19.	COD	mg/l	20	5
D.	**Bacteriological Parameters**			
20.	Total Coliforms	CFU/ 100 ml	5×10^3	52×10^2
21.	Faecal Coliforms	CFU/100 ml	520	50

CFU: Colony Forming Unit

***Note:** Phuljhar river is not a perennial river. Sample was collected from the accumulated water in the river flow path. Hence, some of the water quality parameter like TDS, conductivity, chlorides, sulphates and sodium were found on higher side.

Table 3.3.4: Characteristics of Sea Water at Vadinar Jetty

Sr. No.	Parameters	Units	Vadinar Jetty
A.	**Physical Parameters**		
1.	pH		7.4
2.	Temperature	(^{0}C)	28
3.	Turbidity	(NTU)	0.46
4.	Total suspended solids	(mg/l)	23
5.	Total Dissolved Solids	(mg/l)	38729
6.	Conductivity	(µS/cm)	86000
B.	**Inorganic Parameters**		
7.	Total Alkalinity (as $CaCO_3$)	mg/l	176
8.	Total Hardness (as $CaCO_3$)	mg/l	3090
9.	Calcium Hardness (as $CaCO_3$)	mg/l	116
10.	Chlorides	mg/l	25000
11.	Sulphates	mg/l	3371
12.	Sodium	mg/l	10854
13.	Potassium	mg/l	732
C.	**Nutrient and Demand Parameters**		
14.	Nitrate as NO_3	mg/l	0.6
15.	Total Phosphates	mg/l	0.1
16.	Fluoride	mg/l	5.7
17.	Oil & Grease	mg/l	0
18.	BOD	mg/l	16
19.	COD	mg/l	1010
D.	**Bacteriological Parameters**		
20.	Total Coliforms	CFU/100 ml	1620
21.	Faecal Coliforms	CFU/100 ml	130

CFU: Colony Forming Unit

Table 3.3.5: Characteristics of Refinery ETP Inlet and Outlet Water

Sr. No.	Parameters	Units	ETP Inlet	ETP outlet
A.	**Physical Parameters**			
1.	pH		9.1	7.5
2.	Temperature	(^{0}C)	41	35
3.	Turbidity	(NTU)	74	1.2
4.	Total Suspended Solids	(mg/l)	47.5	2
5.	Total Dissolved Solids	(mg/l)	496	563
6.	Conductivity	(µS/cm)	894	838
B.	**Inorganic Parameters**			
7.	Total Alkalinity (as $CaCO_3$)	mg/l	320	202
8.	Total Hardness (as $CaCO_3$)	mg/l	260	46
9.	Calcium Hardness (as $CaCO_3$)	mg/l	54	38
10.	Chloride	mg/l	135	167
11.	Sulphate	mg/l	64	49
12.	Sodium	mg/l	354	201
13.	Potassium	mg/l	2.0	1.3
C.	**Nutrient and Demand Parameters**			
14.	Nitrate as NO_3	mg/l	5.3	18.9
15.	Total Phosphates	mg/l	0	0.2
16.	Fluoride	mg/l	0.4	0.7
17.	Oil & Grease	mg/l	23	0
18.	BOD	mg/l	19	1.6
19.	COD	mg/l	301	12
D.	**Bacteriological Parameters**			
20.	Total Coliforms	CFU/100 ml	82×10^4	9×10^2
21.	Faecal Coliforms	CFU/100 ml	ND	ND

CFU: Colony Forming Unit

Table 3.3.6: Characteristics of Drinking Water Supplied to Nearby Villages by Refinery

Sr. No.	Parameters	Unit	Sample Values	Acceptable/ Permissible Limit (IS 10500:2012)
A.	**Physical Parameters**			
1.	pH		7.5	6.5-8.5 / No Relaxation
2.	Temperature	(^{0}C)	31	--
3.	Turbidity	(NTU)	0.8	1 / 5
4.	Total suspended solids	(mg/l)	4	--
5.	Total Dissolved Solids	(mg/l)	197	500 / 2000
6.	Conductivity	(µS/cm)	384	--
B.	**Inorganic Parameters**			
7.	Total Alkalinity (as $CaCO_3$)	mg/l	202	200 / 600
8.	Total Hardness (as $CaCO_3$)	mg/l	112	200 / 600
9.	Calcium Hardness (as $CaCO_3$)	mg/l	42	75 / 200
10.	Chlorides	mg/l	12	250 / 1000
11.	Sulphates	mg/l	12	200 / 400
12.	Sodium	mg/l	63	--
13.	Potassium	mg/l	3.1	--
C.	**Nutrient and Demand Parameters**			
14.	Nitrate as NO_3	mg/l	1.9	45 / No Relaxation
15.	Total Phosphates	mg/l	0.1	--
16.	Fluoride	mg/l	1	1.0 / 1.5
17.	Oil & Grease	mg/l	0	--
18.	BOD	mg/l	0	--
19.	COD	mg/l	0	--
D.	**Bacteriological Parameters**			
20.	Total Coliforms	CFU/100 ml	106×10^3	Nil
21.	Faecal Coliforms	CFU/100 ml	6	Nil

Table 3.3.7: Heavy Metals in Water Samples

Sr. No.	Sampling Site/ Village	Source	Metal Content (mg/l)			
			Cr	Mn	Fe	Cu
Ground Water Sources (Dug Wells)						
1.	Zankhar (W1)	Dug Well	0.01	BDL	0.03	0.02
2.	Vadinar (W2)	Dug Well	0.00	0.00	0.14	0.00
3.	Bharana (W3)	Dug Well	BDL	BDL	0.01	BDL
4.	Mithoi (W4)	Dug Well	0.00	BDL	0.05	BDL
5.	Mota Manda (W5)	Dug Well	0.05	BDL	0.10	BDL
6.	Kajurda (W6)	Dug Well	0.03	BDL	0.08	BDL
7.	Refinery Complex (W7)	Dug Well	BDL	0.05	0.04	0.01
Surface Water Sources						
8.	Phuljhar River (W8)	Surface	BDL	BDL	0.01	0.01
9.	Sinhan Dam (W9)	Surface	0.00	0.06	0.27	0.01
Sea Water						
10.	Vadinar Jetty (W10)	Sea	BDL	BDL	0.06	BDL
Refinery ETP Water						
11.	ETP Inlet (W11)	ETP	BDL	BDL	0.00	0.01
12.	ETP Outlet (W12)	ETP	0.03	0.00	0.18	BDL
Supplied Drinking Water						
13.	Water supplied to Villages by Tanker (W13)	Narmada River	0.21	BDL	0.12	BDL
Drinking Water Quality Standards IS: 10500 – 2012 (permissible/ acceptable)			0.05 / No relaxation	0.1/0.3	0.3/ No relaxation	0.5/1.5

Other metals like Al, Pb, Cd, Co, Zn & Ni were below detectable limits.

Table 3.3.8: Species Composition of Phytoplankton in Surface and Ground Water Samples

Sr. No.	Sampling Location	Phyto-plankton (Sp/mL)	Percentage Composition of Algal Group (%)							SWDI
			Chlorophyceae	Bacillariophyceae	Chrysophyceae	Euglenophyceae	Gymnodiniaceae	Cynophyceae	Peridiniaceae	
Dug Wells										
1.	Zankhar	38	85	4	ND	7	4	ND	ND	2.4
2.	Vadinar	462	99	1	ND	ND	ND	ND	ND	0.1
3.	Bharana	ND	ND	ND	ND	ND	ND	ND	ND	ND
4.	Mithoi	ND	ND	ND	ND	ND	ND	ND	ND	ND
5.	Mota Manda	ND	ND	ND	ND	ND	ND	ND	ND	ND
6.	Kajurda	13	89	11	ND	ND	ND	ND	ND	2.1
7.	Refinery	17	75	17	ND	ND	ND	8	ND	2.0
Surface Water										
8.	Phuljhar River	46	91	6	ND	ND	ND	ND	3	1.8
9.	Sinhan Dam	38	98	2	ND	ND	ND	ND	ND	1.7
Sea Water										
10.	Vadinar Jetty	84	95	2	3	ND	ND	ND	ND	1.0

Table 3.3.9: Phytoplankton Species observed in Water Samples

Sr. No.	Sampling Location	Percentage Composition of Algal Group (%)						
		Chlorophyceae	Bacillariophyceae	Chrysophyceae	Euglenophyceae	Gymnodiniaceae	Cynophyceae	Peridiniaceae
Dug Wells								
1.	Zankhar	Gomphosphaeria, Oocystis, Ulothrix, Chlorococcus, Nostoc, Chaetomorpha, Chodatella	Navicula	ND	Eutreptia	Amphi-dinum	ND	ND
2.	Vadinar	Gomphosphaeria, Phytoconis	Nitzschia	ND	ND	ND	ND	ND
3.	Bharana	ND	ND	ND	ND	ND	ND	ND
4.	Mithoi	ND	ND	ND	ND	ND	ND	ND
5.	Mota Manda	ND	ND	ND	ND	ND	ND	ND
6.	Kajurda	Spirulina, Draparnalda, Ulothrix, Chaetomorpha	Cymbella	ND	ND	ND	ND	ND
7.	Refinery	Microspora, Ulothrix, Stichococcus	Cymbella	ND	ND	ND	Lyngbya	ND
	Remarks	• Usually it was found that dug well water is free of phytoplanktons but presence of the phytoplanktons in dug well shows the contamination of water due to various human activities. This is also supported by a study by Aboubakar Sako et.al., (2018) • Ulothrix Sp. shows both fresh water and sea water habitat.						
Surface Water								
8.	Phuljhar River	Chlorella, Phytoconis, Anabena, Nostoc, Gomphosphaeria	Navicula	ND	ND	ND	ND	Peridinium
9.	Sinhan Dam	Oedogonium Chlorococcus Nostoc Botryococuss Phytoconis	Navicula Nitzchia	ND	ND	ND	ND	ND

		Planktosphaeria Enteromorpha Diacanthos						
	Remarks	• Species recorded in water samples are commonly found in surface water.						
Sea Water								
10.	Vadinar Jetty	Oedogonium Chlorococcus Nostoc Ulothrix Volvox	Nitzchia	Cosmarium, Mougeotia	ND	ND	ND	ND
	Remarks	• Oedogonium and chlorococcus is adaptable organism and usually found in polluted area. These species appearance in sea water may be attributed to their evolutionary trend. • Nostoc Sp. shows both fresh water and sea water habitat. • Ulothrix Sp. shows both fresh water and sea water habitat. • Nitzchia sp. found in sea water supported by study of Ganjian A et. al., (2009). • Cosmarium though is a fresh water algae. Its presence in sea water shows its evolutionary adaption in wide climatic condition.This is also supported by a study of Marija Stamenković & Dieter Hanelt (2013).						

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Table 3.3.10: Species composition of Zooplankton in Surface and Ground Water Samples

Sr. No.	Sampling Location	Zooplanktons (Sp/m^3)	Percentage Organism in Groups (%)			SWDI
			Rotifer	Cladocera	Copepoda	
Dug Wells						
1.	Zankhar	2667	25	75	ND	0.81
2.	Vadinar	7333	36	18	45	1.5
3.	Bharana	ND	ND	ND	ND	ND
4.	Mithoi	ND	ND	ND	ND	ND
5.	Mota Manda	ND	ND	ND	ND	ND
6.	Kajurda	2000	ND	100	ND	0.01
7.	Refinery	6667	90	ND	10	0.47
Surface Water						
8.	Phuljhar River	9333	79	21	ND	0.03
9.	Sinhan Dam	7333	55	9	36	1.32
Sea Water						
10.	Vadinar Jetty	4667	14	57	29	1.38

3.4 Land Environment

3.4.1 Soil Quality Assessment

Impact on land environment from industrial activities could be mainly attributed to disposal of solid/hazardous waste and discharge of wastewater either on land or into water bodies, or while being used as irrigation water. The importance of impacts on land environment also depends on several factors like the project location, landuse/ land cover in the surrounding area. The baseline status of land environment has been assessed through reconnaissance in project area, characterization of soils through field studies and study of landuse pattern.

The project site status consists of rocky and strata made up of mainly black and yellow clay and layers of different size of sand. Agriculture is the main source of occupation in the study area. Soil in study area is medium textured. The main crops grown during the study period were cotton, groundnut, maize and sugarcane.

3.4.1.1 Soil Sampling Locations & Analytical Methods

Soil samples were collected from eight villages within the study area and one sample was collected from green belt area of the refinery. Representative soil samples were collected upto depth of 15 cm. Sampling locations are summarized in **Table 3.4.1** and are also shown in **Fig. 3.4.1.** Photographs taken during soil sampling are shown in **Plate 3.4.1**.

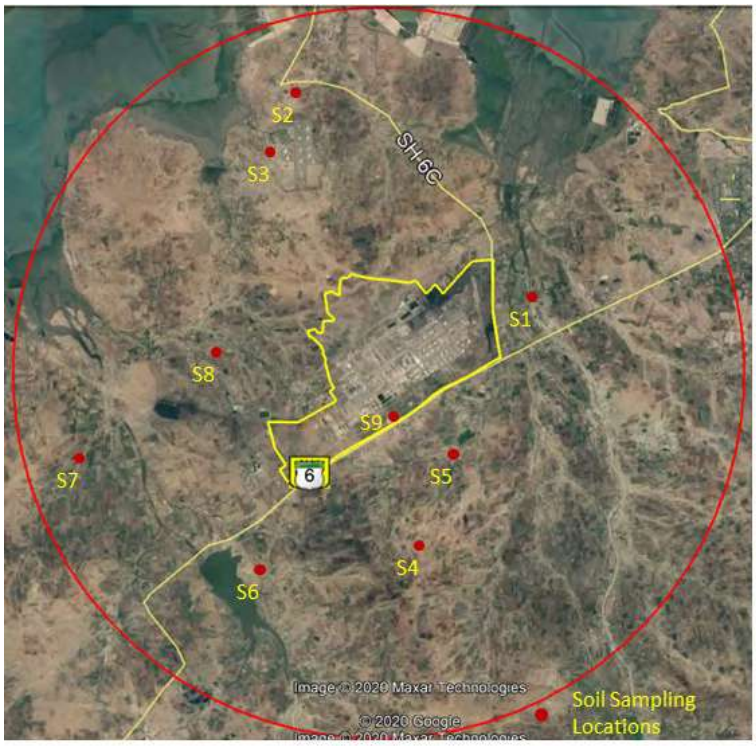


Fig. 3.4.1: Map showing Soil Sampling Locations

Samples were analysed for various physico-chemical parameters, heavy metals and microbiological characteristics, following the Standard methods. The International Pipette Method (Black, 1964) was adopted for determination of particle size analysis. The textural diagram was generated using "SEE Soil Class 2.0 version based on United States Department of Agriculture (USDA) classification of soils. Physical parameters such as bulk density, porosity and water holding capacity were determined by following KR Box Method (Keen and Raczkowski, 1921). The chemical characteristics of soil were determined by preparing soil extract in distilled water in ratio 1:2 (as per Jackson procedure, 1967).

Organic carbon was determined by Walkley & Black method (1972). Total nitrogen and nitrate nitrogen were determined by Kjeldahl Method as per Jackson procedure 1967 and the Total phosphorous was determined by vanadomolybdate yellow color method. Fertility status of soil in terms of available nitrogen was determined by Kjeldahl Method and available phosphorus was determined by Chlorostannous Reduced Molybdo Phosphorus Blue colour Olsen's method (1954) and available potassium was determined by flame photometer method (Jackson M.L.1967). Heavy metals in the soil were determined by extracting soil with conc. H_2SO_4 and conc. HNO_3 followed by analysis on ICP or AAS (APHA, 1995).

3.4.1.2 Soil Quality Characteristics

a. Physical Properties of Soil

Air-dried and sieved samples have been used for determination of physical properties of soil. Soil characteristics such as the particle size distribution of impact zone in terms of percentage of sand, silt and clay are presented in **Table 3.4.2.** Sand, silt and clay content in the soil of the study area varied from 54-68%, 18-30% and 8 to 22%, respectively. The soils of the study area are moderately textured having sandy loam and sandy clay loam textural class in the impact zone **(Fig. 3.4.2).**

The physical characteristics of soils viz., bulk density, porosity and water holding capacity are presented in **Table 3.4.3.** The soil being of friable consistency, the bulk density of the soil was in the range of 1.07 to 1.39 g/cm^3, whereas the porosity and water holding capacity were found in the range of 64-81% and 47-75%, respectively.

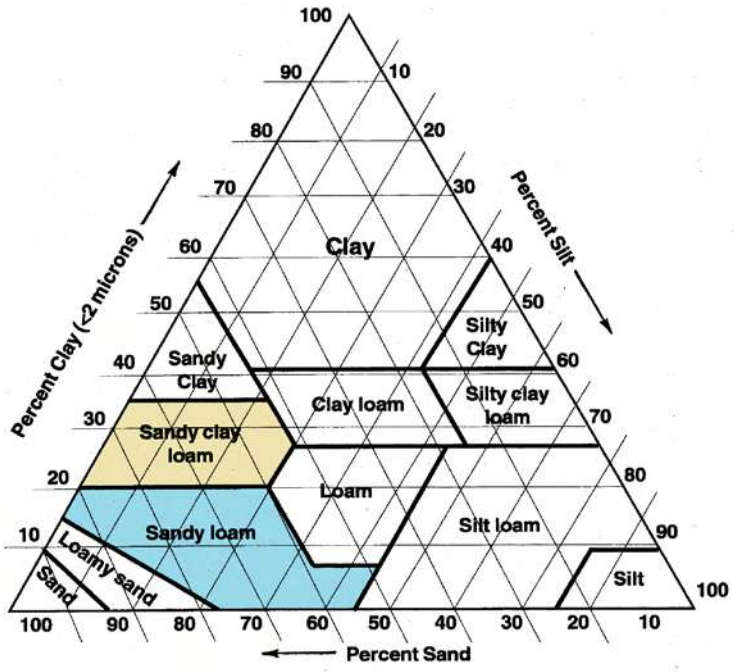


Fig. 3.4.2: Texture Diagram of Soil

b. Chemical Properties of Soil

The collected soil samples were analysed for various chemical properties, such as pH, electrical conductivity, soluble anions and cations, Cation Exchange Capacity (CEC), exchangeable cations, Exchangeable Sodium Percentage (ESP), organic carbon content, nutrient status and heavy metals. The results are presented in **Tables 3.4.4 to 3.4.9.**

pH is an important parameter, which is indicative of the alkaline and acidic nature of soil. It severally affects the microbial population as well as the solubility of metal ions and regulates nutrient availability. The pH of the soil in the study area is neutral to slightly alkaline in reaction having pH is in the range of 7.7 to 8.1. The soluble salts were determined from soil extract (1:2). The soluble salts are expressed in terms of electrical conductivity (EC). The EC of the soil extract in the study area was in the range of 390 to 1380 µS/Cm**.** The soluble salt content in all the soils were found low **(Table 3.4.4).**

In general, the soil samples in the study area have cation exchange capacity ranging between 30.2-36.1 Cmol (p^+) kg^{-1}. Amongst the different exchangeable cations, calcium (15.0-19.7 Cmol (p^+) kg^{-1}) is prominent followed by magnesium (15.0-19.7 Cmol (p^+) kg^{-1}) in the soil samples within study area. The concentration of cations is shown in **Tables 3.4.5.** The Exchangeable Sodium Percentage (ESP) varied between 1.64 -9.32. Soils from all the locations are normal with respective to alkalinity as exchangeable sodium percentage of soil is below 15. The classification of soil and their relationship with productivity and adsorptivity based on cation exchange capacity is presented in **Tables 3.4.6 and 3.4.7**, respectively. The soils fell under the category of very high adsorptivity and moderate productivity.

c. Nutrient Status of Soil

Organic matter present in the soil influences its physical and chemical properties. It commonly accounts as one third or more of the cation exchange capacity of surface soil and is also responsible for stability of soil aggregates. The concentration of Organic carbon and available nitrogen, phosphorous and potassium of the soil samples are given in **Table 3.4.8.** The organic carbon ranged between 0.58 -1.33%. The concentration of available nitrogen, phosphorus (as P_2O_5) and potassium ranged between 452-715 kg/ha, 0.77-7.74 kg/ha and 426-866 kg/ha, respectively.

The soils were assessed on the basis of organic carbon percent and it was observed that soil samples belonged to fertile category except the soil sample of green belt location within the refinery which was under medium class. Soil Nitrogen, was under medium to fertile class. Phosphorus (as P_2O_5) is mostly in bound form in the soil. The phosphorus content in the soil was very low and was categorized under poor class except for the sample collected from green belt area within the refinery which belonged to medium class. Potassium (as K_2O) was under fertile class. The fertility status of the soil with respect to interpretation at different levels is given in **Table 3.4.9.** Overall fertility status of the soils reveals that the soils belonged to medium to fertile class.

d. Heavy Metal Content in the Soil

Heavy metal content with respect to cadmium, chromium, cobalt, copper, lead, iron, manganese, nickel and zinc was determined in all the soil samples. The results are given in **Table 3.4.10.**

e. Soil Microbiology

Soil microorganisms play a key role in nutrient transformation, organic form is transformed into their respective inorganic forms and plants are able to absorb them for their growth. Physico-chemical characteristics of soil and its nutrient status influence the microbial population. Microorganisms present in samples of soil are presented in **Tables 3.4.11**. Various ecological cycles in the Rhizosphere zone of the plant depend upon microbiological population. The population of bacteria, fungi and actinomycetes are the vital components of soils and they help in maintaining their stability.

Azotobactor are non-symbiotic nitrogen fixing micro-organisms and improve soil fertility by fixing nitrogen in soil. Fungi also constitute an important part of the micro flora of normal soil. They are active in initial stages of decomposition of plant residues and actively participate in the process of soil aggregation. Total viable microbial count (TVC) population ranged mostly between $3x10^4$-$15x10^6$, except at Vadinar village, where it was only 220. Rhizobium and Azotobactor were as high as $15x10^3$ in Singach and $20x10^4$ in Mithoi villages, respectively. Further, the Fungi & Actinomycetes being associated with decomposition was as high as $62x10^2$ in Bharana and $98x10^4$ in Sinhan villages. Further the microbial count with respect to all micro-organisms was lowest in the soil sample collected from Vadinar village.

3.4.2 Land Use Pattern of the Study Area

3.4.2.1 Land use as per Census Records

As per 2011 Census records, land use pattern in different villages falling within 10 km radial distance from the project site has been classified under the following categories:

- Forest Area
- Area under Non-Agricultural Uses
- Barren & Un-cultivable Land Area
- Permanent Pastures and Other Grazing Land Area
- Land under Miscellaneous Tree Crops etc. Area
- Culturable Waste Land Area
- Fallows Land other than Current Fallows
- Current Fallows Area
- Net Area Sown

Village-wise details of land uses are given in **Table 3.4.12**. Out of the total geographical area of about 29048 ha, about 56% area comes under Lalpur Tehsil, 36.4% under Khambalia Tehsil and rest 7.6% under Jamnagar. Net sown area is 57.8%. Forest area is only 0.1% (31.57 ha). Area under non-agricultural uses and culturable waste land is 7.1% and 2.4% respectively. Barren and un-cultivable lands are about 17.2%. The study area is covered with 6.3% permanent pasture and other grazing land. The total land under miscellaneous tree crops etc. land area is 2.4% of the total land area. Fallow land other than current fallows area, and current fallows area is 3.8% and 2.9% respectively. The percentage distribution of land under different categories is depicted in **Fig. 3.4.3.**

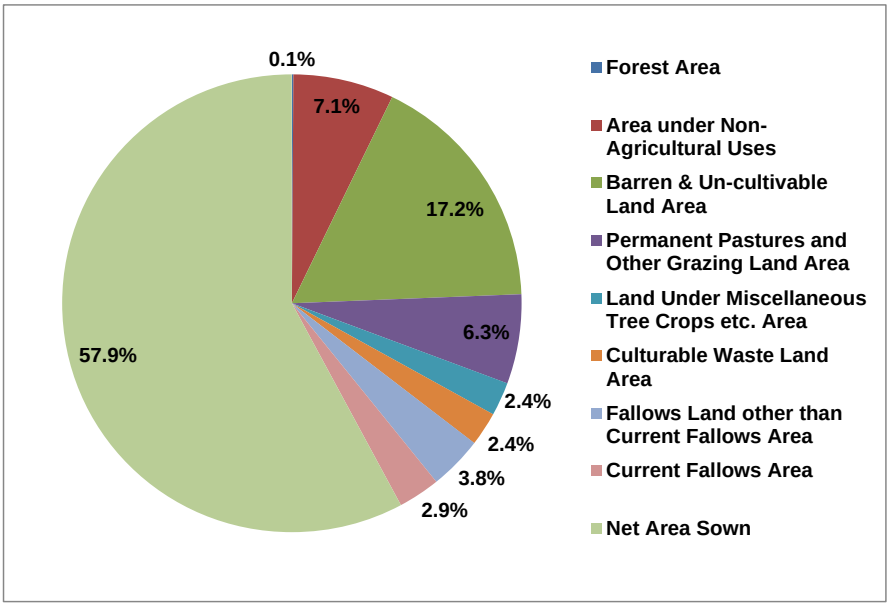


Fig. 3.4.3: Land use Pattern as per 2011 Census Records

3.4.2.2 Landuse and Land cover Classification using Remote Sensing Data

Remote Sensing (RS) is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with object, area, or phenomenon under investigation. It provides a large variety and amount of data about the earth surface for detailed analysis with the help of various space borne and airborne sensors.

"Geographic Information System (GIS) is an information system that is used to input, store, retrieve, manipulate, analyze and output geographically referenced data or geospatial data, in order to support decision making for planning and management of land use & land cover, natural resources, environment, transportation, urban facilities, and other administrative records".

Both, RS & GIS present powerful capabilities for understanding and managing earth resources. These two techniques are used to measure the land cover, from which land use can be inferred particularly with ancillary data or prior knowledge.

Land use and land cover (LULC) represent cover of the Earth's surface. The terms of land use and land cover is often used interchangeably, but each term has its own unique meaning. Land cover–refers to the characteristics and physical cover of the Earth's Surface, as represented by natural elements like vegetation, water, bare earth, impervious surface and other physical features of the land. Land use–refers to the description of how people utilize the land for the socio-economic activity, as represented by man-made elements like agricultural land, recreation area, built-up land etc. When used together the phrase land use and land cover generally refers to the categorization or classification of human activities and natural elements on the landscape within a specific time frame based on established scientific and statistical methods of analysis of appropriate source materials. Preliminary survey was conducted to understand the present overlay of LULC. Different types of land use and land cover in the study area are shown in **Plate 3.4.2**.

In order to prepare LULC for the study area, the basic images were procured from National Remote Sensing Center (NRSC), Hyderabad for the 2016, which represent combined scenario of different LULC images taken during different seasons in the year. The various LULC classes interpreted in the study area include built-up land (industrial area, village and town), agricultural land (single crop land, double cropland and fallow land), forest land (forest plantation, scrub forest and degraded forest), waste land (land with scrub, gullied/ravines land and barren rocky/stony waste/sheet rock area) and water bodies.

Land Use and Land Cover Analysis & Results

LULC map prepared for 10 km buffer of Nayara Energy Ltd. is shown in **Fig. 3.4.4**. Total geographical area of study area is 314.16 km^2. In the study seven classes was considered; i) agricultural land, ii) built-up land, iii) fallow land, iv) forest land, v) littoral swamp land, vi) wasteland and vii) water bodies. The analysis revealed that as

much as 153.85 km^2 of the area was covered by fallow land, 75.25 km^2 of the area covered by wasteland, built-up land covered 32.85 km^2 and water bodies covered 31.35 km^2. Agricultural land covered 12.13 km^2, littoral swamp land covered 6.37 km^2 and Forest land covered only 2.36 km^2 as shown in **Table 3.4.13**, and described subsequently.

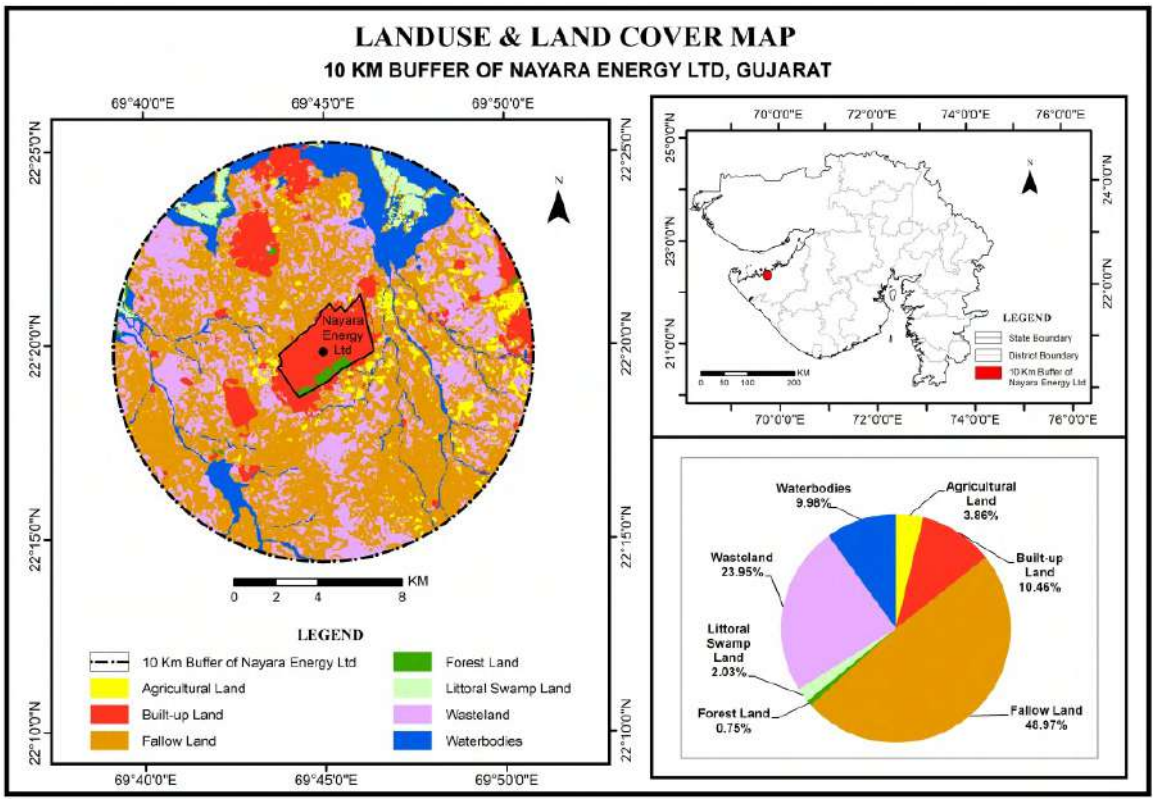


Fig. 3.4.4: LULC Map of 10 km Radial Study Area

a. Agricultural Land

In the land use and land cover map (LULC) one of the important component is agricultural land. This encompasses both cultivated (single crop land) and irrigated lands (double crop land). These are the lands mainly used for farming and for production of food and other commercial and horticultural crops. With the help of satellite data, it is possible to identify various agricultural land uses. These include the agricultural areas identified by their characteristic red tone, regular shaped agricultural fields and in associated with settlements, water bodies, etc. Crop lands are found in and around the water bodies. Major crops cultivated in kharif season are groundnut, cotton, castor etc. and rabi season crops are cumin, coriander, ajwain etc. The agricultural land is occupying only 3.86% of the area; which is minor land use category.

b. Built-up Land

This is an area of human habitation developed due to non-agricultural use and has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. Towns/cities, industrial area & villages incorporate in built-up land. It is an area essentially used for human habitation and has both residential and commercial activities. It includes permanent buildings of single, double or high rise buildings. It also includes temporary establishments. This class was identified with their dark bluish green tone in the center and bluish tone on the periphery, and shows a coarse texture. The built-up land is covering 10.46% of the area; which is one of the major LULC categories.

c. Fallow Land

It is described as agricultural land which is taken up for cultivation but is temporarily allowed to rest, un-cropped for one or more seasons, but not less than one year. These lands are particularly those which are seen devoid of crops at the time when the imagery is taken of both seasons. Maximum area is covered by fallow land; which is as high as 48.97%.

d. Forest Land

Forest comprises of thick and dense canopy of tall trees, which predominantly remain green throughout the year. These lands are discerned by their red to dark red tone and varying in sizes. Based on the tonal and textural variations, the forests of the study area were divided into three categories as forest plantation, deciduous forest and degraded/scrub forest. Forest plantations belong to forest department include tree species. Deciduous forest comprises of vegetation composed primarily of broad-leaved trees that shed all their leaves during once a year, especially during summer. Degraded/scrub forest, comprises of land with degraded scrubs, bushes and smaller trees. These are the forest areas which have poor tree cover with mixed formations of shrubs and scrub, generally seen at the fringes of forests cover and settlements, where there is biotic and abiotic interference. The forest land is occupying only 0.75% of the total study area; and can be termed as minor LULC category.

e. Littoral Swamp Land

These are evergreen in nature, halophytic in nature, dense or woody in nature, occurring along tidal waters/creeks, estuaries and along the delta in coastal areas. These are tropical and subtropical vegetation species that are densely colonized in coastal on tidal flats, estuaries salt marshes etc. The littoral swamp land is occupying 2.03% of the study area, and comes under minor LULC category.

f. Wasteland

A wasteland is a place that's empty and desolate, with no sign of life or growth. An area may be a wasteland because of toxic materials in the soil, or due to climate conditions like strong winds. Scrubland, gullied/ravines land & barren rocky/ stony waste/sheet rock area etc. incorporates in wasteland. It is a degraded land which is not used for any purpose. The wasteland is covering 23.95% of the area and it is a one of the major LULC category.

g. Water bodies

This category comprises areas with surface water bodies, either impounded in the form of ponds, lakes and reservoirs or flowing as streams, rivers, canals etc,. These are identified on satellite image in blue to dark blue or cyan in tone depending on the depth of water. Lakes, ponds, tanks and reservoirs are the source of water for agriculture and domestic purpose in the study area. Depending on the monsoon rainfall and utilization of water, both wet and dry water bodies are seen. Water bodies cover an area of 9.98%; and come under the major LULC category.

Overall, the study area was mainly dominated by fallow land & waste land LULC, which accounted for as high as 72.92% of the total study area.

Ground Truthing for Data Verification

The doubtful areas identified during the preliminary interpretation were marked on the maps for planning the traverse and checking the details on the ground. The doubtful areas were physically verified by the study team during field studies in July 2018, as shown in **Plate 3.4.3**. Field observation about the LULC was noted for use in the modification of thematic details. List of ground truthing locations are given in **Table 3.4.14.**

1. Zankhar, 2. Vadinar, 3. Bharana, 4. Singach, 5. Sinhan, 6. Mota Mandha

Plate 3.4.1: Photographs showing Collection of Soil Samples in the Study Area

Plate 3.4.2: Different Types of LULC in the Study Area

Plate 3.4.3: Study Team for Ground Truthing in the Study Area

Table 3.4.1: Soil Sampling Locations

Sample Code	Location	Latitude	Longitude
S1	Zankhar Village	22°20'42.82"N	69°47'2.70"E
S2	Vadinar Village	22°24'17.94"N	69°43'18.77"E
S3	Bharana Village	22°23'1.32"N	69°42'39.46"E
S4	Singach Village	22°17'29.52"N	69°45'20.24"E
S5	Mithoi Village	22°18'54.30"N	69°45'46.88"E
S6	Sinhan Village	22°16'45.51"N	69°42'28.43"E
S7	Mota Manda Village	22°18'22.45"N	69°40'4.97"E
S8	Khajurda Village	22°19'45.61"N	69°41'50.22"E
S9	Green Belt Area in Refinery	22°19'6.70"N	69°45'4.87"E

Table 3.4.2: Texture Class of Soil Samples

Sr. No.	Sampling Location	Particle Size Distribution (%)			
		Sand	Silt	Clay	Textural Class
1.	Zankhar Village	67	18	14	Sandy loam
2.	Vadinar Village	63	28	8	Sandy loam
3.	Bharana Village	53	30	16	Sandy loam
4.	Singach Village	58	20	22	Sandy clay Loam
5.	Mithoi Village	54	24	22	Sandy clay Loam
6.	Sinhan Village	54	24	22	Sandy clay Loam
7.	Mota Manda Village	58	20	22	Sandy clay Loam
8.	Khajurda Village	60	22	18	Sandy loam
9.	Green Belt Area in Refinery	68	22	10	Sandy loam

Table 3.4.3: Physical Characteristics of Soil Samples

Sr. No.	Sampling Location	Bulk Density (gm/cm^3)	Porosity (%)	Water Holding Capacity (%)
1.	Zankhar Village	1.29	69	55
2.	Vadinar Village	1.39	64	47
3.	Bharana Village	1.30	81	66
4.	Singach Village	1.29	73	58
5.	Mithoi Village	1.39	71	53
6.	Sinhan Village	1.39	78	58
7.	Mota Manda Village	1.29	78	63
8.	Khajurda Village	1.33	69	53
9.	Green Belt Area in Refinery	1.07	79	75

Table 3.4.4: Chemical Characteristics of Soil Extract (1:2)

Sr. No.	Sampling Location	pH	EC µS/Cm	Ca	Mg	Na	K
				meq/l			
1.	Zankhar Village	7.7	1280	3.4	2.4	9.2	0.05
2.	Vadinar Village	8.1	410	1.5	0.5	1.4	0.05
3.	Bharana Village	8.1	410	0.8	0.4	2.6	0.13
4.	Singach Village	8.1	1250	2.6	2.4	9.1	0.13
5.	Mithoi Village	8.0	1380	3.4	2.2	10.4	0.20
6.	Sinhan Village	8.1	390	2.2	0.8	1.2	0.25
7.	Mota Manda Village	8.1	970	1.8	1.2	5.9	0.05
8.	Khajurda Village	8.0	1120	3.0	1.4	8.2	0.07
9.	Green Belt Area in Refinery	7.8	760	2.4	0.6	2.7	1.19

Table 3.4.5: Cation Exchange Capacity of Soil Samples

Sr. No.	Sampling Location	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CEC	ESP
		C mole (p^{+}) kg^{-1}					
1.	Zankhar Village	18.1	13.5	3.29	0.41	35.1	9.32
2.	Vadinar Village	15.0	8.0	0.67	0.41	30.2	2.76
3.	Bharana Village	19.7	13.7	2.26	0.48	34.2	6.27
4.	Singach Village	17.3	13.9	2.77	0.52	35.3	8.04
5.	Mithoi Village	18.0	14.0	3.17	0.43	35.8	8.89
6.	Sinhan Village	16.3	17.2	0.57	0.83	36.1	1.64
7.	Mota Manda Village	18.4	17.6	2.95	0.43	34.9	7.49
8.	Khajurda Village	18.2	16.8	3.09	0.42	33.8	8.04
9.	Green Belt Area in Refinery	16.1	13.7	1.07	0.56	32.2	3.42

Table 3.4.6: Relationship of CEC with Productivity

CEC	Range (cmol (p^{+}) kg^{-1}	Productivity	Sample Code
Very Low	<10	Very Low	-
Low	10-20	Low	-
Moderate	20-50	Moderate	S1,S2,S3,S4,S5,S6,S7,S8,S9
High	>50	High	-

Table 3.4.7: Relationship of CEC with Adsorptivity

CEC	Range (cmol (p^+) kg^{-1}	Adsorptivity	Sample Code
Limited or Low	<10	Limited or Low	-
Moderate	10-20	Moderate	-
High	20-30	High	S1,S2,S3,S4,S5,S6,S7,S8,S9
Very High	>30	Very High	-

Table 3.4.8: Fertility Status of Soil Samples in Study Area

Sr. No.	Sampling Location	Organic carbon (%)	N	P_2O_5	K_2O
			kg/ha		
1.	Zankhar Village	0.99	640	1.55	428
2.	Vadinar Village	1.05	602	0.77	426
3.	Bharana Village	1.10	652	1.55	499
4.	Singach Village	1.33	640	3.87	541
5.	Mithoi Village	0.81	502	0.77	456
6.	Sinhan Village	1.05	715	2.32	866
7.	Mota Manda Village	1.26	527	7.74	455
8.	Khajurda Village	1.17	677	0.77	441
9.	Green Belt Area in Refinery	0.58	452	55.73	591
Level in Poor Soil		<0.5	<280	<23	<136
Level in Medium soil		0.5-0.75	280-560	23-57	133-337.5
Level in Fertile Soil		>0.75	>560	>57	>337.5

Table 3.4.9: Fertility Status of Soil Samples during 2018

Parameter	Range	Level of Fertility	Sample Code
Organic Carbon (%)	<0.5	Poor Soil	
	0.5-0.75	Medium Soil	S9
	>0.75	Fertile Soil	S1,S2,S3,S4,S5,S6,S7,S8
Nitrogen (kg/ha)	<280	Poor Soil	
	280-560	Medium Soil	S5,S7,S9
	>560	Fertile Soil	S1,S2,S3,S4,S6,S8
P_2O_5 (kg/ha)	<23	Poor Soil	S1,S2,S3,S4,S5,S6,S7,S8
	23-57	Medium Soil	S9
	>57	Fertile Soil	
K_2O (kg/ha)	<136	Poor Soil	
	133-337.5	Medium Soil	
	>337.5	Fertile Soil	S1,S2,S3,S4,S5,S6,S7,S8,S9

Table 3.4.10: Heavy Metals in Soil Samples

Sr. No.	Location / Village	Metal Content (mg/kg)								
		Al	Cr	Mn	Fe	Co	Ni	Cu	Zn	Cd
1.	Zankhar	BDL	11.3	150	35726	11.9	BDL	10.2	BDL	58.7
2.	Vadinar	BDL	39.5	225	42132	18.4	BDL	13.8	BDL	50.2
3.	Bharana	BDL	12.9	129	31272	13.1	BDL	2.2	BDL	30.2
4.	Singach	BDL	18.1	155	40576	15.0	BDL	BDL	BDL	43.6
5.	Mithoi	BDL	68.6	167	33539	13.9	BDL	BDL	BDL	35.1
6.	Sinhan	BDL	12.8	146	33764	13.2	BDL	BDL	BDL	37.2
7.	Mota Manda	BDL	3.5	97.5	24080	8.4	BDL	BDL	BDL	26.1
8.	Khajurda	BDL	2.4	65.2	22491	8.6	BDL	BDL	BDL	25.3
9.	Green Belt in Refinery	BDL	49.3	20.0	15725	5.2	BDL	13.0	BDL	15.0

Table 3.4.11: Microbiological Characteristics of Soil

Sr. No.	Sampling Location	TVC	Fungi	Actinomycetes	Rhizobium	Azotobacter
		CFU/g of Soil				
1.	Zankhar Village	11×10^5	320	162×10^3	78×10^2	25×10^3
2.	Vadinar Village	220	120	180	70	100
3.	Bharana Village	3×10^4	62×10^2	15×10^3	850	580
4.	Singach Village	16×10^5	13×10^2	41×10^4	15×10^3	6×10^3
5.	Mithoi Village	12×10^6	520	55×10^4	12×10^3	20×10^4
6.	Sinhan Village	55×10^5	150	98×10^4	63×10^2	43×10^3
7.	Mota Manda Village	15×10^6	9×10^2	56×10^4	32×10^3	55×10^3
8.	Khajurda Village	42×10^5	45×10^2	25×10^4	12×10^3	28×10^2
9.	Green Belt Area in Refinery	85×10^5	1×10^4	14×10^4	72×10^3	43×10^3

Table 3.4.12: Land use Pattern (Area in Hectares)

Sr. No.	Village Code	Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Permanent Pastures and Other Grazing Land Area	Land Under Miscellaneous Tree Crops etc. Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
	Lalpur Tehsil											
1.	513868	Zankhar	3099.28	0.00	186.90	909.47	57.87	578.54	120.03	134.04	309.59	802.8
2.	513880	Mithoi	1281.17	0.00	127.00	38.00	71.00	38.00	66.00	0.00	0.00	941.1
3.	513881	Rasangpar	1363.69	25.00	0.00	133.00	111.00	33.00	101.00	0.00	0.00	960.6
4.	513878	Khatiya Beraja	504.91	0.00	0.00	188.10	19.91	0.00	0.00	0.00	0.00	296.9
5.	513879	Lakhiya Nana	437.63	0.00	20.00	105.00	0.00	0.00	0.00	21.07	0.00	291.5
6.	513882	Lakhiya Mota	1101.12	0.00	4.00	140.00	63.00	2.00	0.00	18.00	0.00	874.1
7.	513883	Rangpar	979.29	0.00	0.00	177.00	89.00	2.00	0.00	0.00	0.00	711.2
8.	513869	Jogvad	1038.48	3.69	107.90	275.45	38.01	0.00	35.41	4.32	23.26	550.4
9.	513870	Meghpar	331.94	0.00	0.00	13.00	56.00	0.00	0.00	88.00	73.00	101.9
10.	513867	Singach	1473.39	0.00	8.66	121.85	201.35	0.00	26.35	45.88	0.00	1069.3
11.	513895	Modpar	2559.87	0.00	3.53	60.35	243.59	0.00	0.00	0.00	415.90	1836.5
12.	513871	Padana	2105.61	0.00	15.00	134.00	218.00	0.00	0.00	317.00	0.00	1421.6
	Total A		**16276.38**	**28.69**	**472.99**	**2295.22**	**1168.73**	**653.54**	**348.79**	**628.31**	**821.75**	**9857.9**

	Khambhalia Tehsil											
13.	513494	Nana Mandha	1484.71	0.00	96.72	418.44	116.95	0.00	27.04	0.00	0.00	825.5
14.	513495	Nana Ambla	407.28	0.00	29.94	72.84	10.11	0.00	23.25	0.00	0.00	271.1
15.	513496	Mota Ambla	881.28	0.00	9.91	240.78	29.13	0.30	0.00	0.00	0.00	601.1
16.	513497	Vadinar	669.79	0.00	182.92	24.52	33.17	0.00	0.00	0.00	0.00	429.1
17.	513498	Bharana	1849.81	0.00	40.58	194.16	45.84	33.89	78.31	303.65	9.78	1143.6
18.	513499	Timbdi	967.68	0.00	210.43	153.37	53.63	0.00	8.38	0.00	0.00	541.8
19.	513500	Kathi Devaliya	559.14	0.00	291.78	12.61	33.58	0.00	0.00	0.00	0.00	221.1
20.	513501	Kajurda	1150.00	0.00	467.60	107.64	13.35	0.00	132.23	0.00	0.00	429.1
21.	513502	Sumra Taradhari	872.01	0.00	28.00	321.32	69.19	0.00	12.54	0.00	1.47	439.4
22.	513503	Vadaliya Sinhan	1010.94	0.00	56.03	113.12	57.06	0.00	40.06	0.05	0.00	744.6
23.	513504	Sakhpar	725.49	2.88	27.39	333.93	20.23	0.00	14.16	12.16	18.66	296.0
	Total B		**10578.13**	**2.88**	**1441.3**	**1992.73**	**482.24**	**34.19**	**335.97**	**315.86**	**29.91**	**5942.4**
	Jamnagar											
24.	513599	Gagva	676.82	0.00	8.95	48.62	78.06	0.00	8.09	39.81	0.00	493.2
25.	513600	Moti Khavdi	1516.39	0.00	130.59	655.10	105.60	0.00	0.00	110.00	0.00	515.1
	Total C		**2193.21**	**0**	**139.54**	**703.72**	**183.66**	**0**	**8.09**	**149.81**	**0**	**1008.3**
	Grand Total		**29047.72**	**31.57**	**2053.83**	**4991.67**	**1834.63**	**687.73**	**692.85**	**1093.9**	**851.66**	**.6809.8**

Source: District Census Abstract 2011, Gujarat

Table 3.4.13: LULC Classification within the Study Area

Sr. No.	LULC Category	Area in km^2	Area in %
1.	Agricultural Land	12.13	3.86
2.	Built-up Land	32.85	10.46
3.	Fallow Land	153.85	48.97
4.	Forest Land	2.36	0.75
5.	Littoral Swamp Land	6.37	2.03
6.	Wasteland	75.25	23.95
7.	Water bodies	31.35	9.98
	Total Area	**314.16**	**100.00**

Table 3.4.14: Ground Truth Locations in 10 km Buffer of Nayara Energy Ltd.

Sr. No.	Locations	Latitude	Longitude	Observations
1.	Zankhar Village	22°21'13.799"N	69°45'48.241"E	Agricultural Land
2.	Modpur Village	22°16'2.717"N	69°47'41.660"E	
3.	Varana Village	22°22'57.735"N	69°43'40.857"E	
4.	Forest Office (Near Sihan Dam)	22°16'47.580"N	69°41'33.300"E	Built-up Land
5.	Zankhar Village	22°21'34.080"N	69°46'15.450"E	
6.	Kajurda Village	22°18'30.207"N	69°42'39.500"E	
7.	Mithoi Village	22°18'30.516"N	69°44'11.129"E	
8.	Modpur Village	22°15'53.693"N	69°48'3.806"E	
9.	Nayara Energy Ltd. Main Entrance	22°19'16.602"N	69°45'15.901"E	
10.	Timbdi Village	22°20'49.811"N	69°42'5.095"E	
11.	Vadinar Village (Indian Oil Colony)	22°24'17.339"N	69°43'6.899"E	
12.	Zankhar Village	22°21'56.678"N	69°45'32.405"E	Fallow Land
13.	Kajurda Village	22°19'13.340"N	69°42'38.160"E	
14.	Mota Mandha Village	22°18'38.079"N	69°39'36.472"E	
15.	Rasangpar Village	22°17'0.657"N	69°46'19.684"E	
16.	Marine National Park (Near Vadinar Village)	22°26'40.50"N	69°42'11.40"E	Forest Land
17.	Timbdi Village	22°20'57.258"N	69°43'0.738"E	Waste Land
18.	Vadinar Village	22°24'33.391"N	69°44'35.791"E	
19.	Meghpar Village	22°20'33.600"N	69°48'13.900"E	Water bodies
20.	Zankhar Village	22°20'8.295"N	69°46'46.368"E	

3.5 Biological Environment

Natural flora and fauna are organized into natural communities and constantly interact with their physical environment as well as among themselves. They show varied responses and sensitivities to external environmental pressures. Hence, for a meaningful assessment, it is necessary to understand the ecological status of the proposed site for any development project before evaluating the probable environmental impact of the project. The factors that are responsible for change in biodiversity structure can be direct or indirect. This impact can be maintained at a minimal level or can even be ameliorated if the proposed activities envisaged in the project probably shift in order to maintain dynamic equilibrium in the ecosystem through the intricate interactions between the operative abiotic and biotic factors.

The baseline status for biological environment has been established by assessing the distribution pattern, community structure and species composition of flora and fauna in and around existing refinery up to 10 km radius during summer season, 2018 at Vadinar, Gujarat. In view of presence of marine national park in the region, the study area upto 15 km radius from the refinery has been considered.

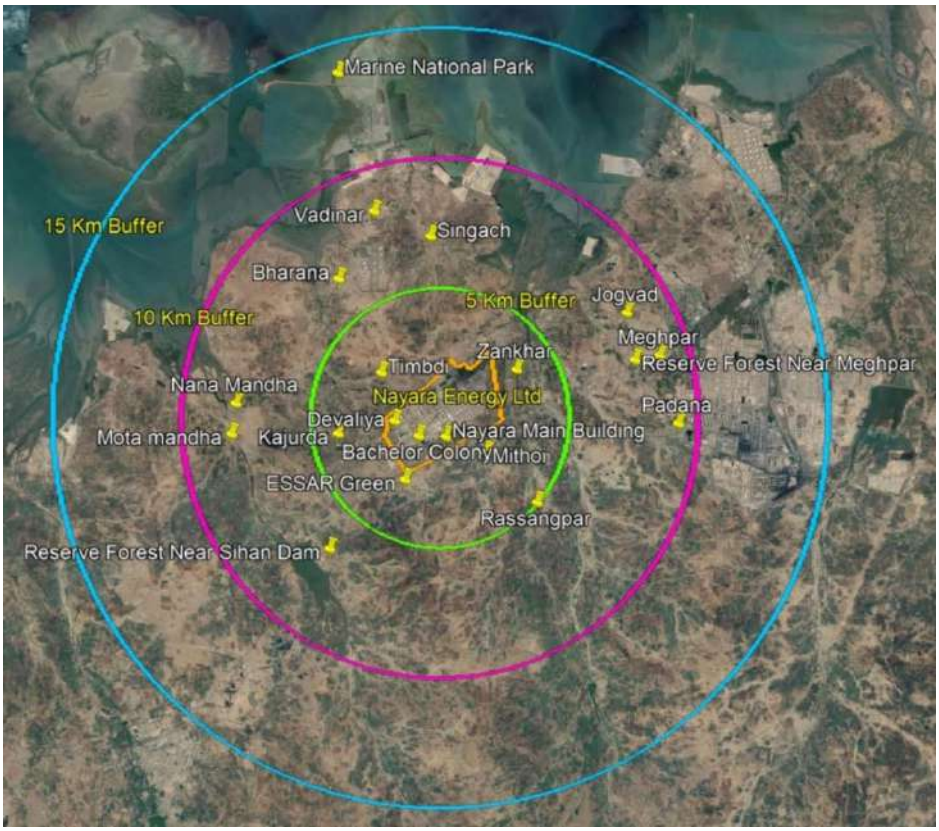
The following aspects have been covered in the present study.

- Assessment and inventorization of baseline status of flora and fauna within the study area
- Identification of rare plants of economic importance including medicinal plants and wildlife species in study area through primary survey
- Assessment and inventorization of presence of rare, endangered and threatened species of flora (aquatic & terrestrial) and fauna (avifauna, reptiles, mammals and insects), etc. and identification of measures for protection and conservation of RET species
- To list out all the species of Flora and Fauna found in the study area as per the working plan of Forest Deptt.
- Secondary data collection followed by primary survey related to mangroves, wildlife, fisheries, forest, agriculture and horticulture activity in the study area
- Delineation of possible impacts and biological stress due to proposed activities on terrestrial biota
- To delineate mitigation measures with effective Environment Management Plan to reduce the pressures and probable negative impacts on terrestrial and aquatic biota

3.5.1 Floral Assessment

3.5.1.1 Sampling Locations and Data Collection Approach

To generate the baseline biological quality, a reconnaissance survey was done and sampling locations were identified within the proposed study area. Qualitative assessment was carried out in the study area. Sampling locations are shown in **Fig. 3.5.1** and details are given in **Table 3.5.1**.



Source: Google Earth

Fig. 3.5.1: Biological Sampling Locations in the Extended Study Area (15 km Radius)

In all, 20 sampling locations were identified for the collection of baseline data. Sampling locations were selected by random sampling technique and as per vegetation pattern present in the area. Visual observations and listing method for flora and fauna were carried out at the proposed site, forest patches, and agriculture fields and in several villages within the study area. The biological sampling locations for primary data survey were identified during site visit which includes nearby villages namely Zankhar, Timbdi, Mithoi, Bachelor Colony, Devaliya, Nayara Green and Nayara Building comes in close vicinity (0-5 km); whereas Singhach, Kajurda, Vadinar, Jogvad, Padana, Meghpar,

Nana Mandha, Mota Mandha, Bharana and Rasangpur were situated far from proposed project site (5-10 km).

The sampling stations also comprised of two Reserved Forests; one was near Meghpar village and other was located near Sihan Dam. Marine National Park existing within 15 km radius was also studied.

Photographs taken during the field studies for ecological survey, mangrove study, livestock and cropping pattern analysis are shown in **Plate 3.5.1**.

3.5.1.2 Status of Flora (Structure and Species Composition)

According to the Forest Department of Jamnagar, during the year 2005-06, there was 1659.36 km^2 forest area in the Jamnagar district. Out of which 464.13 km^2 area was under the reserved category, 6.71 km^2 was under protected forest category and 1188.52 km^2 was under unclassified forest. The forest areas of the District are classified into three different categories, namely, (i) Mangrove forests (ii) Open Scrub forest and (iii) Grassland. The main forest products are Cher wood, Karod leaves etc. whereas gum, grass, madhuka-indica, hognut, soupnut, diaspar, milenoxilon etc. are some of the minor forest produces (District Human Development Report, Jamnagar, 2015).

The baseline surveys were conducted to assess the composition, diversity, distribution and their status in the nature by taking observations on diverse plant species. The forest area in the site was scattered and was very limited in its extent. The study area exhibits meagre diversity of flora and the natural vegetation prominently consists of the trees followed by shrubs, herbs, grasses and climbers. As per survey conducted by NEERI team, a total of 93 plant species were recorded during floristic survey in the chosen sampling stations. As per the status in red data book only one tree species *Roystonea regia* (royal palm) belonged to critically endangered category and *Santalum album* (Sandal wood) belonged to vulnerable category.

A complete list of plant species found in the study area representing different types of trees, shrubs, herbs, succulent plants, climbers and grasses are given in **Table 3.5.2,** and are briefly described here.

(A) Trees

Tree species diversity and spatial distribution in forest are greatly influenced by biogeography, niche requirement and disturbance. They form major structural and functional basis of forest, and are vital as carbon sinks, water sheds, provide shades and home for many life forms and above all, act as a primary harvester of energy into the ecosystem. They play an important role in building top canopy of forest land.

Prosopis juliflora (Vilayati Babul) was observed as a dominant flora, widely spread all over the region. Natural vegetation of the study area comprises of trees species viz. *Acacia nilotica* (Desi babul), *Tectona grandis* (Teak), *Peltophorum pterocarpum* (Yellow flame), *Ficus relegiosa* (Peepal), *Cassia siamea* (Cassod tree), *Ficus bengalensis* (Banyan tree), *Luceana leucocephala* (Subabool), *Acacia auriculiformis* (Earleaf acacia), *Casuarina equisetifolia* (Whistling pine), *Pithecellobium*

dulce (Jangali jalebi), *Pongamia pinnata* (Karanj), *Phoenix dactylifera* (Date palm), *Delonix regia* (Gulmohar), *Mangifera indica* (Mango), *Tamarindus indica* (Imli), *Butea monosperma* (Palash), *Azadirachta indic*a (Neem), *Sizygium cumini* (Jamun), *Eucalyptus species* (Nilgiri), *Ficus hispida* (Bokhedo), *Terminalia cattapa* (*Desi badam*), *Aegle marmelos* (Bel), *Ziziphus mauritiana* (Ber), etc. Some of the tree species were noticed along the agriculture field boundaries such as Neem, Date palm, Nilgiri, *Prosopis julifora*, etc.

Jamnagar Forest Department and the Refinery carried out plantation of *Delonix regia* (Gulmohar), *Tamarindus indica*, *Peltophorum pterocarpum*, *Bauhinia variegata* (Apta), *Tectona grandis*, *Alstonia scholaris* (Saptaparni), etc. on barren lands and along roadside.

Some of the tree species observed by the study team in the region are shown in **Plate 3.5.2**.

(B) Shrubs

The shrub species observed in the study area were *Calotropis procera* (Mudar), *Calotropis gigantean* (Crown Flower), *Hyptis suaveolens* (Wild Tulsi), *Datura inoxia* (Datura), *Lantana camara* (Raimuniya), *Ricinus communis* (Castor), *Abutulon indicum*, *Ipomea carnea* (Morning glory), *Tecoma stans* (Yellow bells), *Agave americana* (Mexican poppy), etc.

(C) Herbs

The study area comprises of varieties of wild herbaceous species. The herbaceous species namely *Cassia tora* (Chakunda), *Tridax procumbens* (Coat Buttons), *Alternanthera sessilis* (Sessile Joyweed), *Achyranthes aspera* (Latjira), *Sida acuta* (Common Wireweed), *Sida cordifolia* (Barial), *Calocasia esculenta* (Arvi), *Euphorbia hirta* (Asthma-plant), *Argemone mexicana* (Mexican poppy), *Solanum xanthocarpum* (Kateli), *Senna occidentalis* (Coffeeweed), etc. were recorded in the study area. Due to summer season during site visit, most of the herbs were not seen in the study area.

Some of the shrubs and herb species observed by the study team in the region are shown in **Plate 3.5.3**.

(D) Climbers

Climbers were recorded in the study area during site visit which included *Ipomea sagittifolia, Ipomea triloba, Ipomea alba* (Moonflower), *Ipomoea lacunosa* (White morning-glory), *Pergularia daemia* (Utaran), etc. *Momordica charantia* (Karela) was recorded in the agriculture fields and backyard of villager's house. Bouganvillia *spectabilis* was observed within the project site area. Some of the climbers species observed in the study are shown in **Plate 3.5.4.**

(E) Cactus & Succulent Plants

Cactus is one of the dominant species found in dry climatic conditions. Cactus has fleshy succulent stems that are major organs of photosynthesis and the plants flower in three distinct colours: white, yellow and red. The flowers first appear in early May through the early summer and the fruit ripen from August through October. The study area exhibits hot semi-arid climate condition which supports growth of many succulent plants. Field visits were conducted across various villages, agriculture fields, forest patches, also to some people's house gardens that have a personal collection of cactus and succulent. During field studies, photograph of each succulent plant was taken along with habit, stem, leaves and other floral parts and relevant information was collected. All the species were identified with the help of available literature.

During site visit many cacti species were found which included *Opuntia stricta* (Prickly Pear, Nagphana), *Euphorbia tirucalli* (Pencil cactus), *Acanthocereus species* (Triangle cactus), *Myrtillocactus geometrizans* (Bilberry cactus), etc. The farmers grow *Euphorbia tirucalli* along the agriculture field boundaries, as this plant has capacity to resist the wind. The succulent plants recorded in the study area were *Euphorbia milii* (Christ thorn), *Aloe barbadensis* (Aloe vera), *Nerium indicum* (Kaner), etc. The ripe fruit of *Opuntia stricta* was eaten by local people and was observed at all the sampling stations. Some of the Succulent plants observed in the study area are shown in **Plate 3.5.5.**

(F) Grasses

Over grazing, short and irregular rains have drastically reduced the productivity of the grass land of the region. During the site visit, common grass species noticed in the study area were *Cyanodon dactylon* (Doob grass), *Parthenium hysterophorus* (Congress grass), *Digitaria sanguinalis* (Crabgrass) and *Echinochloa colona* (Jungle rice), etc. *Typha angustifolia* (Patera) was found to be dominant grass in the study area

Comprehensive list of all the above species, as per Forest Working Plan of Jamnagar district is given in **Table 3.5.3.** This includes 76 species of trees, 47 species of herbs and shrubs, 16 species of climbers and 23 species of bamboo and grasses.

(G) Medicinal Plants in the Study Area

Medicinal plants have been prescribed and used widely for thousands of years to treat various disorders and ailments in traditional herbal medicine systems all over the world and have considerable importance in international trade today. There is an increasing demand for the utilization of medicinal plants for providing primary health care to populations, as they are extensively available and inexpensive. According to the World Health Organization (WHO), about 80 % of the population around the world depends on traditional medicine, mostly herbal remedies, for their primary health care needs.

The vegetation in the area harbours a variety of medicinal and aromatic plants. The survey conducted on medicinal plants includes the identification of medicinal plant species, plant part used and mode of healing properties. The medicinal plants observed in the study area were *Hyptis species, Lantana camara, Tridax procumbens, Azadirachta indica, Eucalyptus species, Butea monosperma, Emblica officinalis, Ziziphus mauritiana, Annona squamosa, Murraya koenigii, Aegle marmelos,* etc. *Opuntia stricta* has a great medicinal value and is considered as a potential source of natural red colourants. This plant with high water use efficiency produces forage for animals, vegetables, and fruits with glucose. Euphorbia tirucalli is also one of the important medicinal plants.

Details of medicinal plants observed in the study area are given in **Table 3.5.4.**

3.5.1.3 Agroforestry in the Study Area

During the field studies it was observed that agroforestry is active in the area and is the main source of income for the villagers. The main crops of the study area were Millet (Jowar), Bajari, Wheat, Groundnut and Cotton. Groundnut and cotton are important commercial crops, whereas wheat constitutes the irrigated crops. The other cash crops observed in the study area were: *Sessamum indicum* (Til), *Ricinus communis* (Castor), *Triticum aestavum* (Wheat), *Brassia compestris* (Mustard), *Zea mayz* (Maize), etc. and the fruits like *Musa paradisiaca* (Banana), *Carica papaya* (Papaya), *Psidium guajava* (Guava), *Manilkara zapota* (Chikoo), *Mangifera indica* (Mango), *Sizygium cumini* (Jamun), *Annona squamosa* (Sitaphal), *Cocos nucifera* (Coconut), etc. Some plants like *Citrus lemon* (Lemon), *Ziziphus jujube* (Ber), *Tamarindus indica* (Imli), *Emblica officinalis* (Amla) and Terminalia catappa (Desi Badam), were recorded in village area and in wild habitat within the project site area. In Jogvad village, plantation of Malabar Neem (*Melia dubia*) along with Chandan (*Santalum album*) plants as a mixed crop was observed in agriculture fields. Malabar Neem plant is grown by the villagers for plywood and pulp purpose **(Plate 3.5.6** and **Table 3.5.5)**.

The secondary data on agriculture activities were collected from District Agriculture Office, Jamnagar for the years 2013-14 to 2015-16. Area, total production and productivity/yield of major crops (like sugarcane, oilseeds, food grains, pulses, cereals, onion, tobacco, seasmum, groundnut, urad, mung, maize, rice, bajra & jowar) in Jamnagar district during 2013-14 to 2015-16 are given in **Table 3.5.6**, which shows considerable variation in productivity of many crops during different years.

3.5.1.4 Horticulture Activity & Social Forestry in the Study Area

As per secondary data, the horticulrure crop plants in the study area comprise of spices, vegetables, fruit plants, flowering and ornamental crops, etc. The main fruit crops are Mango, Chickoo, Citrus, Ber, Banana, Guava, Pomegranate, Date palm, Papaya, Custard apple, Cashew nuts, Amla and Coconut. The other fruit crops includes Fig, Grapes, Jamun, Mosambi, Tad, Fanas, Tamarind, Orange, Desi Badam, Bijora (wild lemon), Wood apple, Khirni, Bel, Falsa, Gunda, etc.

Area, total production and productivity/yield of various fruit crops (like mango, chiku, citrus, ber, banana, guava, pomegranate, date palm, papaya, custard apple, aonla, cashew nuts, coconut and others) in Jamnagar district during 2013-14 to 2016-17 is presented in **Table 3.5.7**, which shows considerable consistent productivity of different fruit crops during these three years.

The vegetable crops grown in the area are Potato, Onion, Brinjal, Cabbage, Okra, Tomato, Cauliflower, Clusterbean, Cow pea, Cucurbits, etc. The cucurbit crop plants comprises of Bottle gourd, Bitter gourd, Sweet melon, Smooth gourd, Ridge gourd, Cucumber, Pointed gourd, Watermelon, Pumpkin, Tindora, Valor, Papadi, Kankoda (Spiny gourd), etc. The spices comprise of main crops like Cumin, Fennel, Dry Chillies, Garlic, Coriander, Ginger, Turmeric, Fenugreek, Isabgul, Ajwain, Suwa, etc. Apart from this, extensive cultivation of flowering plants was also noticed as per information gathered from villagers and Horticulture Department. These crops includes Rose, Marigold, Mogra, Lily and others ornamental plants (Directorate of Horticulture Regulatory, Jamnagar).

Area, total production and productivity/yield of various vegetable crops (like potato, onion, brinjal, cabbage, okra, tomato, cauliflower, cluster bean, cowpea, cucurbits and others) in Jamnagar district during 2013-14 to 2016-17 is presented in **Table 3.5.8**, which shows considerable consistent productivity of different vegetables during these three years.

Social plantations done by Nayara Energy Limited around the refinery areas and township include various ornamental plants like *Bauhinia variegata, Plumeria rubra, Roystonea regia, Casurina equisitifolia, Delonix regia, Caesalpinia pulcherrima, Nerium indicum, Polyalthia longifolia* and *Bougainvillea glabra*. Trees like *Acacia nilotica, Azadirachta indica, Alstonia scholaris, Albizzia lebbeck, Peltophorum pterocarpum* and *Delonix regia* were observed along the roadside for avenue plantation**.**

3.5.2 Faunal Assessment

A habitat is formed by a particular combination of vegetation and land types in an area, and contributes broadly to major structural vegetation communities. The combined attributes of a habitat may provide a unique set of resources that can support a characteristic fauna assemblage. The diversity in fauna basically depends upon density and diversity of flora. The richer the diversity among the flora better will be the diversity in fauna**.**

Faunal diversity was studied surrounding the 10 km radius area from the proposed site in Refinery complex. The study team observed various faunal species of Avifauna, Insects, Reptiles and Mammalian. The major ecosystems of the study area are water bodies (lakes & ponds), wastelands and agricultural lands. To study impact on biodiversity, the observations were taken at village area, agricultural sites, wasteland areas and water bodies.

The wildlife species in the project area have been listed based on the field observations, information collected from the local people and available secondary data from Jamnagar Forest Division. Field surveys were carried out in the month of July, 2018. The visual observations were made during a walk through in the chosen transect for sighting birds, insects, reptiles and mammals in a study area. Surveys for avifaunal observation were carried out early in the morning from 06-10 am and in the late afternoon from 04:30 -06:30 pm. The species were identified by using bird's vocal sounds and photographs. Olympus binocular for viewing birds and camera for photography were also used.

3.5.2.1 Staus of Fauna

Details of various species like mammals, reptiles and birds observed in the study area are given along with their conservation status in **Table 3.5.9**. List of common and important birds, animals and reptiles in Jamnagar district (as per Forest Working Plan) are given in **Table 3.5.10**. Various insects observed during the field studies are listed in **Table 3.5.11**.

Photographs taken during the field studies to represent vaious faunal species are given in **Plate 3.5.7** for mammals, in **Plate 3.5.8** for aquatic species & reptiles, and in **Plate 3.5.9** for avifauna.

The information regarding the faunal diversity within the study area is summarized below.

(A) Mammals

As per management and working plan of Jamnagar District, mammals reported from the study site were Common Fox, Jackal, Nilgai, Wild Boar, Porcupine and Jungle Cat. Wild Hares were also reported to be present in the area as per information gathered from villagers in the study area. Common arboreal species reported are Indian Flying fox/giant fruit bat and bonnet macaque. However, during the field studies, Monkey, Squirrel, Mongoose, Indian field mouse, etc. were observed in the study area. The domestic animals like Dogs, Cats, Cow and Sheeps were commonly found. The Herbivorous species found in the region were *Axix axix*, *Boselaphus tragocamelus*, *Funambulus pinnati*, *Sus scrofa*, *Lepus nigricolis*, *Macaca mulatla*, etc.

(B) Herpetofauna

Herpetofauna comprises Reptiles and Amphibians which are the most important components of the ecosystem. Amphibians represent Frogs, Toad, salamander and newts; while reptiles represent Snakes, Common skinks, Geckos and Garden lizards, Indian chameleon. Monitor Lizard (*Varanus species*), Oriental garden lizard (*Calotes versicolor*) and Fan throated lizard (*Sitana laticeps*) were found in the study area during the site visit.

(C) Avifauna

Birds are essential group of living organisms in every ecosystem and maintain tropic level. Birds play an important role in ecosystem as potential pollinators, scavengers, and control insects & pests and also serve as an excellent ecological indicator. Birds are very specific to their respective habitats and are also key indicators of environment being susceptible to any change. Birds were recorded by both direct sighting and vocal call and found that the bird population of study area was very rich and diverse.

Vadinar area is an urbanized area and the most common bird species are Rock Pigeon, Jungle Crow, House Sparrow, Common Myna, Red vented Bulbul, etc. The avifauna observed during primary survey indicates a good diversity in the study area. The birds species observed were Little egret (*Egretta garzetta*), Great Egret (*Ardea alba*), Intermediate Egret (*Ardea intermedia)*, Pond Herons (*Ardeola grayii*), Greater Flamingo (*Phoenicopterus roseus*), Painted Stork (*Mycteria leucocephala*), Great blue heron (*Ardea herodias*), White-throated Kingfisher (*Halcyon smyrnensis*), Peafowls (*Pavo cristatus)*, Pigeons *(Columba domestica)*, Mynas *(Acridotheres tristis)*, Indian Robin (*Copsychus fulicatus*), Oriental magpie-robin (*Copsychus saularis*), Red-wattled lapwing *(Vanellus indicus)*, Laughing Dove (*Spilopelia senegalensis*), Green bee-eater (*Merops orientalis*), etc. The study area was dominated by the presence of Green bee-eater, Cattle egret, Black Drongo, Red-wattled lapwing, Black-winged stilt and Purple sunbird.

(D) Insects

The insects are known to be the most successful and diverse animal on earth. They have adapted for almost every conveyable type of environment from the equator to the arctic and from sea level to the snowfield of highest mountains on land in air and water and almost everywhere. Insects carry tremendous ecological significance and play an important role in various ecological processes. A wide range of birds, amphibians, reptiles and mammals depends upon them for survival.

The forests of the study area have good diversity of insects which comprises of a number of Anisoptera (Dragonflies), Lepidoptera (Butterflies), Zygoptera (Damselflies), Araneae (Spider), etc. During field visit, the study team observed various colourful and beautiful insects under Odonata order like *Brachythemis contaminata, Orthetrum sabina* etc. The Odonata were most abundant order followed by Lepidoptera having the species namely *Eurema hecabe*, Coleoptera, Hemiptera, Diptera and Orthoptera. The Beetles (Lady Bird Beetle, Chafer beetle, Blister beetle etc), Assassin bug, Aquarius species, House fly, Bumble bee, etc. were also observed by the study team. Other insects namely Red stink bug (*Melamphaus species*), Housefly (*Musca domestica*) and Indian honey bee (*Apis cerana indica*) were also seen in the study area.

3.5.3 Livestock Holding

Livestock are the integral part of economy and village ecosystems of any area. Livestock rearing as an economic activity is pursued by certain sections of the community who have made grazing and breeding of livestock as their traditional occupation. Cattles and small ruminants (goats and sheep) were seen in the study area. Every farmer owns buffalos and cows; other animals reared in the study area include Cats, Dog, Hens, and Rabbit, *etc.* The cooperative milk sector does not have its own district union in Jamnagar district. In the current stage, it is the Rajkot District Milk Union Limited that has extended its network support to collect milk from the villages in Jamnagar district. The cattle breeds were found healthy in the study area. They feed on agricultural remains and open scrubland.

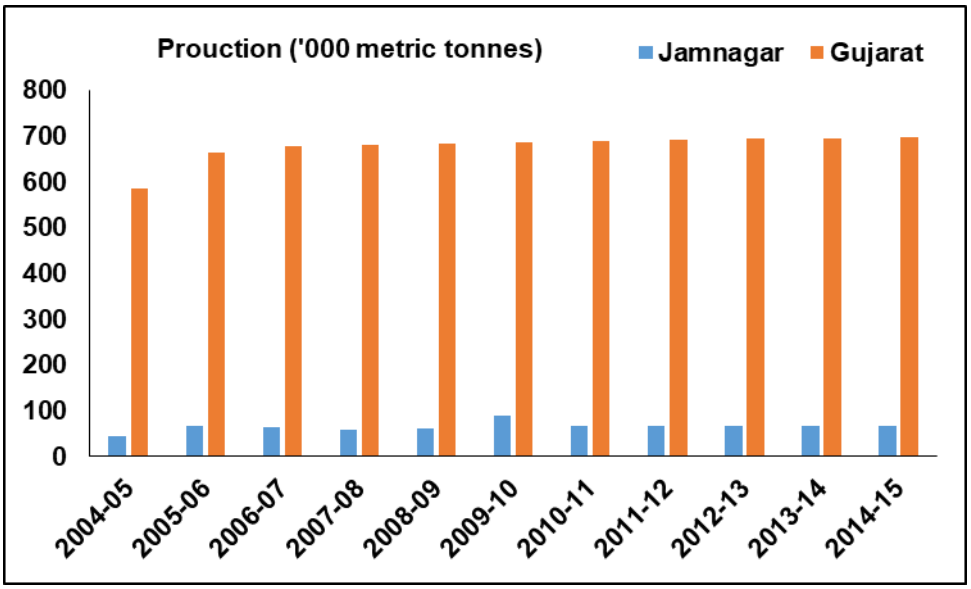
As per 19th Cattle Census conducted in 2012, total livestock population in Jamnagar district is as under:

Cattle	-	204191
Buffalo	-	162812
Camels	-	2205
Sheep	-	211290
Goat	-	179839
Horse	-	731
Donkeys and mules	-	692
Rabbits	-	296
Birds	-	19650

3.5.4 Fisheries

Fisheries and marine resources constitute another important source of livelihood in the coastal talukas. The sea coast is the main source of fisheries in Jamnagar. The important fishing centres of the district are Jodiya, Sachana, Bedi, Samrat, Bharana, Salaya and Okha. The fishing population is found in Jamnagar, Khambhalia, Okhamandal, Jodia and Kalyanpur talukas only. The list of major fish species found in the district documented by Fisheries Department, Jamnagar are given in **Table 3.5.12**.

The marine Fish production in Jamnagar with respect to total production in Gujarat from 2004-05 to 2014-15 is shown in **Fig. 3.5.2**. It is observed that the production in last decade ranged between 7.85% to 12.85%, highest being in 2009-10.



Source: Fishery Statics 2014-15, Commissioner of Fisheries, Government of Gujarat, Gandhinagar).

Fig. 3.5.2: Year-wise Marine Fish Production in Jamnagar District and the Gujarat State during 2004-05 to 2014-15

3.5.5 Ecologically Sensitive Areas

3.5.5.1 Marine National Park

It is India's first Marine National Park established in 1982. The marine sanctuary area has various species of hard & soft corals, prawns, sponges, crabs, turtles, water birds and brown, green & red algae. The Marine National Park & Sanctuary has coral reefs, mangroves, sea-grass beds, mudflats, network of creeks and other ecosystems which support rich marine life & bird life. Marine National Park is situated in 162.89 km^2 area and 457.92 km^2 of Marine Sanctuary in the Gulf of Kutch. Gulf of Kutch has 42 islands, out of which 33 islands have coral reef. There are islands with sandy beaches and mangrove swamps. These islands are a treasure-trove of marine species and a paradise for birdwatchers. The Jamnagar city is on the coast of Gulf of Kutch in the state of Gujarat & has clean Islands & Beaches, Hills, Temples, Palaces, Forest, Fantastic Bird life in the Bird Sanctuary & Marine Sanctuaries and Fascinating Corals and Marine Life in the Marine National Park. All these attraction makes Jamnagar a good centre for Tourism Development (District Human Development Report, Jamnagar).

The Marine National Park & Sanctuary area has Coral Reefs, 37 species of Hard & Soft Corals, 70 species of Sponges, 27 species of Prawns, 30 species of Crabs, 200 species of Molluscs, Endangered Sea Turtles like the Green Sea, Oliver Riddley & Leather Back, Porpoise, Common Dolphins, Indo-Pacific bottlenose Dolphins and Indo-Pacific hump-backed dolphins. Also it supports growth of algae which comprises of 108 species of brown, green & red algae. Ray fishes which also include Sting Rays are all

found in the marine national park. It has dense mangrove forests with Avicennia marina, Ceriops tagal, Aegiceras corniculatum & Rhizophora mucronata.

During field studies at Marine National Park, dense and luxurious growth of mangroves was seen. The area was dominated by the presence of Avicennia marina and Rhizophora species of mangrove. Fishing activities were also noticed in the marine park area. It also supports breeding ground and migratory path to most of the migratory birds. Flock of Greater Flamingo (*Phoenicopterus roseus*) and Sarus Crane (*Grus antigone*) birds were observed in marine national park during site visit. A number of other birds namely Painted Stork (*Mycteria leucocephala*), Great Blue Heron (*Ardea herodias*) and Great Egret (*Ardea alba*) were also inhabited the area. Status of mangroves and migratory birds observed in the Marine National Park are shown in **Plate 3.5.10**.

3.5.5.2 Reserved Forest

A reserved forest denotes forests accorded a certain degree of protection. Reserving forests is one of the most important measures ever taken to conserve and protect the wildlife- the animals and their habitats. In reserved forests the activities like grazing, haunting etc. are generally banned unless permission is granted for a particular reason. As per Indian Forest Act (IFA) 1927, any forest land or wasteland that is Government property & hasn't been specified as reserved forest, can be declared as Protected Forest as per provisions of chapter (IV) under IFA 1927.

Two reserved forests were found in the study area. One reserved forest was located near Sihan Dam, Danta village with survey no. 322/1. The total area covered in this forest is 87.66 ha. Another reserved forest was located near Meghpar Village and its survey no. is 155. This forest is spread in the 21.20 ha area (Source: Forest Department, Jamnagar).

Ecology and biodiversity survey for flora and fauna was also carried out in these two reserved forests. Both the reserved forests prominently comprised of *Prosopis juliflora* (Junglee Kikar), and most of the species were stunted and bushy growth was observed. The other floral component consists of thorny bushes and variety of dried grasses. *Opuntia stricta* (Prickly Pear) was recorded in both the reserved forests. These Reserved Forests do not have any major plant species of rare and endangered or medicinally important plants and wildlife. Hence, there is no threat envisaged to the present biodiversity of the reserved forests from the proposed project activity.

3.5.6 Plantation/Greenery Status at Nayara Refinery

3.5.6.1 Details of Green Belt Development

The Green Belt developed by Nayara Energy Limited has significant vegetation cover and plant diversity in the region as shown in **Plate 3.5.11**. As the region is dominated with dry thorny i.e. Scrub vegetation, Green belt has been developed in and around the refinery complex including avenue trees and gardens. The species selected include the species recommended as per CPCB guidelines, and some native species

suitable to local climatic conditions are also planted. The tree species like *Dalbergia sissoo*, *Mangifera indica*, *Azadirecta indica*, *Pongamia pinnata*, *Acacia auroculoformis*, *Acacia nilotica*, *Ficus religiosa*, *Casurina equisetifolium* etc were planted in green belt area. Tree species planted for avenue plantation were mainly evergreen plant species, like *Delonix regia*, *Cassia siamea*, *Polyalthia longifolia*, *Cocos nucifera*, *Baunia purphurea* etc as listed in **Table 3.5.13.**

Currently 20 MMTPA refinery is established in 1171 ha area, out of the total project area of 2275 ha. Well-maintained thick Green belt area with associated facilities has been developed in 410 ha, which is 33% of the plant area in the Refinery complex including COT area and Refinery-COT corridor area.

Apart from this, the company has also done voluntary mangrove afforestation in area of 175 ha area. Mangrove plantation was initiated in 2009-10, and its progress report was prepared in January 2011. The seeds sown around 10 years ago have become mature trees. Land Use pattern of the surrounding area will not be affected by the expansion activities, as these will be confined within the existing refinery premises.

3.5.6.2 Details of Horticulture Plantation in Refinery at Vadinar

Plantation has been carried out by Nayara Refinery over the years since its inception. Different plant species like Imli, Pomegranate, Mango, Sapota, Guava, Jamun and other forest species including Karanj, Alstonia, Tebubia, Peltophorum, Neem, Casurina etc. are planted. As observed, Casurina is one of the dominant plant species grown within the refinery as the plant is able to adapt to dry climate and is salt tolerant. The scale-light verticillate leaves and modified needle-like twigs help in reducing transpiration. So far, upto August 2018, more than 3.07 lakh plants have been planted in 410 ha area.

A: Biodiversity Survey at all the Sampling Locations

B: Mangrove Study in Marine National Park

C: Livestock Study in Village Areas

D: Cropping Pattern Study in Agriculture fields

Plate 3.5.1: Photographs showing Visit to Different Loactions in the Study Area for the Survey/Data Collection

A: *Aegle marmelos* (Bel)

B: *Phoenix dactylifera* (Date Palm)

C: *Bauhinia variegata* (Kachnar)

D: *Eucalyptus species* (Nilgiri) along agriculture field

E: *Acacia nilotica* (Desi Babul)

F: *Thespesia populnea* (Indian tulip tree)

G: *Melia azedarach* (Chinaberry tree)

H: *Delonix regia* (Gulmohar)

I: *Prosopis juliflora* (Ganda Baval)

J: *Ficus bengalensis* (Bargad)

Plate 3.5.2: Prominent Tree Species Observed by the Study Team

A: *Euphorbia hirta* (Asthma-weed)

B: *Tridax procumbens* (Coat Buttons)

C: *Lantana camara* (Raimuniya)

D: *Sida cordifolia* (Kharinta)

E: *Calotropis procera* (Rubber Bush)

F: *Lawsonia inermis* (Mehandi)

G: *Sida acuta* (Common wireweed)

H: *Alternanthera sessilis*

Plate 3.5.3: Prominent Shrubs and Herb Species Observed by the Study Team

A: *Ipomoea lacunose* (White morning-glory)

B: *Pergularia daemia* (Utaran)

Plate 3.5.4: Promonent Climber Species Observed by the Study Team

A: *Aloe barbadensis* (Aloe vera)

B: *Euphorbia tirucalli* (Pencil Tree)

C: *Acanthocereus species* (Triangle cactus)

D: *Opuntia stricta* (Prickly Pear)

E: *Euphorbia milii* (Crown of thorns)

Plate 3.5.5: Succulent Species Observed by the Study Team

A: *Gossypium arboretum* (Cotton)

B: *Arachis hypogaea* (Groundnut)

C: *Melia dubia* (Malabar Neem)

D: *Pennisetum glaucum* (Bajra)

E: *Pennisetum purpureum* (Elephant Grass)

F: *Manilkara zapota* (Chikoo)

G: Jijhavi crop of Gujarat

H: Fodder crop for cattles

Plate 3.5.6: Prominent Crops Grown in the Study Region as Observed by the Study Team

A: Palm Squirrel (*Funambulus species*)

B: Greater Indian Fruit Bat (*Pteropus giganteus*)

C: Domestic Sheeps (*Ovis aries*)

D: Kankrej *(Oxen species)*

Plate 3.5.7: Mammals observed by the Study Team

A: Gastropod species

B: Crab species

C: Black garden Ant
(Lasius niger)

D: Coleopteran species

E: Ditch Jewel
(Brachythemis contaminata)

F: Common Windmill
(Byasa polyeuctes)

G: Clover Mite
(Bryobia praetiosa)

H: Fan throated Lizard
(Sitana laticeps)

I: Oriental garden Lizard
(Calotes versicolor)

Plate 3.5.8: Molluscs, Arthropods and Reptiles observed by the Study Team

A: Asian Koel (*Eudynamys scolopaceus*) (Male)

B: Cattle Egret (*Bubulcus ibis*)

C: Red-wattled Lapwing (*Vanellus indicus*)

D: Laughing Dove *(Spilopelia senegalensis)*

E: Greater Flamingo (*Phoenicopterus roseus*)

F: Great Blue Heron (*Ardea herodias*)

G: Painted Stork (*Mycteria leucocephala*)

H: Common Moorhen (*Gallinula chloropus*)

I: Black-winged Stilt (*Himantopus himantopus*)

J: Green bee-eater (*Merops orientalis*)

K: Indian Peafowl (*Pavo cristatus*)

L: Indian House Crow (*Corvus splendens*)

Plate 3.5.9: Avifauna observed by the Study Team (contd...)

M: White-throated Munia (*Euodice malabarica*)

N: Black Drongo (*Dicrurus macrocercus*)

O: Black-hooded Oriole (*Oriolus xanthornus*)

P: Rock Pigeon *(Columba livia)*

Q: White-throated Kingfisher (*Halcyon smyrnensis*)

R: Little Cormorant (*Microcarbo niger*)

S: Great Egret (*Ardea alba*)

T: Lesser Whistling Duck (*Dendrocygna javanica*)

U: Sind Sparrow (*Passer pyrrhonotus*)

V: Indian Golden Oriole (*Oriolus kundoo*)

Plate 3.5.9: Avifauna observed by the Study Team

A & B: Dense Mangrove Patches
C: Pneumatophores of Mangrove
D: Avicina species of Mangrove
E: Flock of Flamingoes
F: Painted Stork & Great Egret

Plate 3.5.10: Mangroves and Migratory Birds Observed at Marine National Park

Plate 3.5.11: Plantation for Green Belt Development in Refinery

Table 3.5.1: Details of Biological Sampling Locations in the Study Area

Sr. No.	Sampling Locations	Location Coordinates		Location wrt Refinery	
		Latitude	Longitude	Direction	Distance (km)
1.	Singach	N 22° 23' 23.05"	E 69° 44' 28.87"	North	6.63
2.	Zankhar	N 22° 20' 42.61"	E 69° 46' 34.84"	North East	3.22
3.	Vadinar	N 22° 23' 50.41 "	E 69° 43' 10.82"	North	8.03
4.	Timbdi	N 22° 20' 29.71 "	E 69° 43' 32.19 "	North West	2.75
5.	Kajurda	N 22° 19' 10.56 "	E 69° 42' 38.85 "	West	4.16
6.	Meghpar	N 22° 21' 9.87"	E 69° 49' 47.10"	East	8.63
7.	Rassangpar	N 22°17' 58.51"	E 69° 47' 12.46"	South East	5.13
8.	Nayara Building	N22°19' 14.12 "	E 69° 45' 4.22"	South	1.09
9.	Nayara Green	N 22° 18' 17.7"	E 69° 44' 12.7"	South West	3.10
10.	Jogvad	N 22° 22' 1.12"	E 69° 48' 59.49"	North East	8.01
11.	Padana	N 22° 19' 46.62"	E 69° 50' 17.30"	East	9.13
12.	Nana Mandha	N 22° 19' 41.2"	E 69° 40' 18.5"	West	8.00
13.	Mota Mandha	N 22° 19' 02.8"	E 69° 40' 14.7"	West	8.23
14.	Bachelor Colony	N 22° 19' 13.10"	E 69° 44' 27.49"	South West	1.41
15.	Bharana	N 22° 22' 23.81"	E 69° 42' 28.24"	North West	6.40
16.	Devaliya	N 22° 19' 30.61"	E 69° 43' 54.03"	West	1.92
17.	Mithoi	N 22° 18' 57.77"	E 69° 46' 0.02"	South East	2.37
18.	Reserve Forest near Meghpar	N 22° 21' 3.06"	E 69° 49' 14.22"	East	7.67
19.	Reserve Forest near Sinhan Dam	N 22° 16' 46.4"	E 69° 42' 35.89"	South West	6.94
20.	Marine National Park	N 22° 26' 40.5"	E 69° 42' 11.4"	North	13.52

Table 3.5.2: List of Flora Observed at Different Sampling Locations in the Study Area during Field Studies (July 2018)

Sr. No.	Botanical Name	Common English Name	Common Hindi Name	Family	IUCN Status
TREES					
1.	*Acacia nilotica*	Gum Arabic	Babool	Mimosaceae	-
2.	*Acacia leucophloea*	White Bark Acacia	Ronjh, Safed Babul	Mimosaceae	LC
3.	*Prosopis juliflora*	Algaroba	Junglee kikar	Mimosaceae	-
4.	*Tectona grandis*	Teak	Sag	Lamiaceae	-
5.	*Peltophorum pterocarpum*	Yellow flame tree	Peela Gulmohar	Caesalpiniaceae	-
6.	*Ficus relegiosa*	Holy Fig tree	Peepal	Moraceae	-
7.	*Cassia siamea*	Thai copper pod	Kassod	Caesalpiniaceae	LC
8.	*Bombax ceiba*	Silk-cotton	Simar	Bombacaceae	-
9.	*Butea monosperma*	Flame of the Forest, Bastard teak	Palash	Fabaceae	DD
10.	*Tamarindus indica*	Tamarind	Imli	Caesalpiniaceae	LC
11.	*Plumeria obtusa*	Pagoda tree	Champa	Apocynaceae	-
12.	*Zizyphus mauritiana*	Indian plum	Ber	Rhamnaceae	-
13.	*Delonix regia*	Royal Poinciana	Gulmohar	Caesalpiniaceae	LC
14.	*Azadirachta indica*	Indian Lilac	Nimb	Meliaceae	LC
15.	*Pongamia pinnata*	Pongam tree	Karanj	Fabaceae	LC
16.	*Luceana leucocephala*	Lead tree	Subabul	Mimosaceae	-
17.	*Alstonia scholaris*	Devil tree	Saptaparni	Apocynaceae	LC
18.	*Pithecellobium dulce*	Sweet Tamarind	Jangali jalebi	Mimosaceae	-
19.	*Bauhinia variegata*	Orchid Tree	Kachnar	Caesalpiniaceae	LC
20.	*Dendrocalamus species*	Solid bamboo	Bans, Bamboo	Poaceae	-
21.	*Dalbergia sissoo*	Indian rosewood	Shisham	Fabaceae	-
22.	*Eucalyptus species*	Nilgiri	Nilgiri	Myrtaceae	-
23.	*Emblica officinalis*	Indian Gooseberry	Amla	Phyllanthaceae	-
24.	*Annona squamosa*	Custard-apple	Sitaphal	Annonaceae	-
25.	*Sesbania species*	Swamp pea	Agasti	Fabaceae	-
26.	*Phoenix dactylifera*	Date palm	Dates	Arecaceae	LC
27.	*Mangifera indica*	Mango	Aam	Anacardiaceae	DD
28.	*Ficus hispida*	Hairy Fig	Kala umbar	Moraceae	-
29.	*Terminalia cattapa*	Indian Almond	Desi badam	Combretaceae	-
30.	*Aegle marmelos*	Wood apple	Bel	Rutaceae	-

Sr. No.	Botanical Name	Common English Name	Common Hindi Name	Family	IUCN Status
31.	*Citrus limon*	Lemon	Nimbu	Rutaceae	-
32.	*Manilkara zapota*	Chikoo	Chikoo	Sapotaceae	-
33.	*Psidium guajava*	Guava	Amrood, Pera	Myrtaceae	-
34.	*Carica papaya*	Papaya, Melon tree	Papita	Caricaceae	DD
35.	*Ficus bengalensis*	Banyan tree	Bargad	Moraceae	-
36.	*Cascabela thevetia* Syn: *Thevetia peruviana*	Yellow oleander	Peeli kaner	Apocynaceae	-
37.	*Casuarina equisetifolia*	Whistling pine	Jungli saru	Casuarinaceae	-
38.	*Acacia auriculiformis*	Earleaf acacia	Bengali babul	Mimosaceae	LC
39.	*Polyalthia longifolia*	Mast Tree	Ashok	Annonaceae	-
40.	*Nerium indicum*	Oleander	Kaner	Apocynaceae	-
41.	*Murraya koenigii*	Curry tree	Kadipatta	Rutaceae	-
42.	*Melia dubia*	Malabar Neem	Kadukhajur	Meliaceae	-
43.	*Santalum album*	Sandalwood	Chandan	Santalaceae	VU
44.	*Plumeria rubra*	Frangipani	Champa	Apocynaceae	-
45.	*Roystonea regia*	Royal palm	Palm	Arecaceae	CR
46.	*Thespesia populnea*	Indian tulip tree	Paras pipal	Malvaceae	LC
47.	*Melia azedarach*	Chinaberry tree	Bakain	Meliaceae	LC
SHRUBS					
48.	*Calotropis procera*	Rubber Bush	Mudar	Asclepiadaceae	-
49.	*Calotropis gigantea*	Crown Flower	Safed aak	Asclepiadaceae	-
50.	*Hyptis suaveolins*	Wild Tulsi	Rantulasi	Lamiaceae	-
51.	*Datura inoxia*	Datura	Safed dhatura	Solanaceae	-
52.	*Lantana camara*	Wild sage	Raimuniya	Verbenaceae	-
53.	*Ricinus communis*	Castor bean	Arandi	Euphorbiaceae	-
54.	*Abutulon indicum*	Indian Mallow	Kanghi	Malvaceae	-
55.	*Ipomea carnea*	Bush Morning glory	Behaya	Convolvulaceae	-
56.	*Tecoma stans*	Yellow bells	Piliya	Bignoniaceae	-
57.	*Punica granatum*	Pomegranate	Anar	Lythraceae	LC
58.	*Caesalpinia pulcherrima*	Peacock Flower	Guletura	Caesalpiniaceae	-
HERBS					
59.	*Cassia tora*	Pot Cassia	Chakunda	Ceasalpiniaceae	-
60.	*Alternanthera sessilis*	Sessile Joyweed	Garundi	Amaranthaceae	LC
61.	*Achyranthes aspera*	Prickly Chaff Flower	Chirchita, Latjira	Amaranthaceae	-

Sr. No.	Botanical Name	Common English Name	Common Hindi Name	Family	IUCN Status
62.	*Sida acuta*	Common Wireweed	Baraira	Malvaceae	-
63.	*Sida cordifolia*	Heart-Leaf Sida	Kharinta, Barial	Malvaceae	-
64.	*Calocasia esculenta*	Taro, Cocoyam	Arvi	Araceae	-
65.	*Euphorbia hirta*	Asthma-weed	Bara dudhi	Euphorbiaceae	-
66.	*Ageratum conyzoides*	Goat weed	Jangli Pudina	Asteraceae	-
67.	*Tridax procumbens*	Coat Buttons	Khal-muriya	Asteraceae	-
68.	*Argemone mexicana*	Mexican Prickly Poppy	Satyanashi	Papaveraceae	-
69.	*Solanum xanthocarpum*	Yellow Berried Nightshade	Kateli	Solaneaceae	-
70.	*Celosia argentea*	Flamingo Feathers	Safed Murga	Amaranthaceae	-
71.	*Tephrosia purpurea*	Wild Indigo	Sharpankha	Fabaceae	-
72.	*Arachis hypogaea*	Groundnut	Magaphali	Fabaceae	-
73.	*Cassia occidentalis, Synonym: Senna occidentalis*	Coffeeweed	Bari kasondi	Caesalpiniaceae	-
SUCCULANT PLANTS					
74.	*Opuntia stricta*	Prickly Pear	Hathhathoria, Naghphana	Cactaceae	LC
75.	*Euphorbia tirucalli*	Pencil Tree	Angli thor	Euphorbiaceae	LC
76.	*Acanthocereus species*	Triangle Cactus		Cactaceae	-
77.	*Myrtillocactus geometrizans*	Bilberry cactus	Blue Candle	Cactaceae	LC
78.	*Euphorbia milii*	Crown of thorns		Euphorbiaceae	DD
79.	*Aloe barbadensis*	Aloe vera	Gheekumari	Asphodelaceae	-
CLIMBERS					
80.	*Ipomea sagittifolia*	Purple heart glory	Ban kalmi	Convolvulaceae	-
81.	*Ipomea triloba*	Little Bell	-	Convolvulaceae	-
82.	*Ipomea alba*	Moonflower	Gulchandi	Convolvulaceae	-
83.	*Ipomoea lacunosa*	White morning-glory	-	Convolvulaceae	-
84.	*Momordica charantia*	Bitter Gourd	Karela	Cucurbitaceae	-
85.	*Bougainvillea spectabilis*	Bougainvillea	Booganvel	Nyctaginaceae	-
86.	*Pergularia daemia*	Pergularia, Sagovani	Utarn	Asclepiadaceae	-
GRASSES					
87.	*Cyanodon dactylon*	Bermuda Grass	Doob	Poaceae	-

Sr. No.	Botanical Name	Common English Name	Common Hindi Name	Family	IUCN Status
88.	*Parthenium hysterophorus*	Congress grass	Gajar ghas, Chatak Chandani	Asteraceae	-
89.	*Digitaria sanguinalis*	Crabgrass	-	Poaceae	-
90.	*Cyperus esculentus*	Nut grass	Bara-nagar-motha	Cyperaceae	LC
91.	*Echinochloa colona*	**Jungle Rice**	Jangli Jhangora	Poaceae	LC
92.	*Cyperus rotundus*	Purple nutsedge	Motha	Cyperaceae	LC
93.	*Typha angustifolia*	Elephant Grass	Patera	Typhaceae	-

Abbreviation: 'LC' Least Concern, 'DD' Data Deficient, 'VU' Vulnerable, 'CR' Critically Endangered.

Table 3.5.3: List of Floral Species as per Forest Working Plan, Jamnagar

Sr. No.	Local Name	Botanical Name	Family	Incidence
TREES				
1.	Akal Kanto	*Bridelia retusa*	Euphorbiaceae	'g'
2.	Akash Neem	*Mellingtonia hortensis*	Bignoniaceae	'lg'
3.	Rangari	*Morinda tinctoria*	Rubiaceae	'c'
4.	Ambo	*Mangifera indica**	Anacardiaceae	'c'
5.	Amla	*Emblica officinalis**	Euphorbiaceae	'v'
6.	Amli	*Tamarindus indica**	Caesalpiniaceae	'c'
7.	Ankol	*Alangium salvifalium*	Alangiaceae	'g'
8.	Arduso	*Ailanthus excelsa**	Simaroubaceae	'c'
9.	Anuri	*Annona squamosa**	Annonaceae	'r'
10.	Aritha	*Sapindus emarginatus*	Sapindaceae	'c'
11.	Arjun Sadad	*Terminalia arjuna*	Combretaceae	'v'
12.	Asundro	*Bauhinia racemosa**	Caesalpiniaceae	'vc'
13.	Asopalav	*Polyalthiam longifolia**	Annonaceae	'v'
14.	Badam	*Terminalia catappa**	Combretaceae	'r'
15.	Bakan Limdo	*Melia azadiracht**	Meliaceae	'c'
16.	Bakul or Borsali	*Mimusops elengi**	Sapotaceae	'c'
17.	Baval	*Acacia nilotica**	Mimosaceae	'c'
18.	Bahedo	*Terminalia bellerica*	Combretaceae	'v'
19.	Bili	*Aegle marmelos**	Rutaceae	'c'
20.	Charal	*Holoptelea integrifolia*	Ulmaceae	'g'
21.	Cher	*Avicennia officinalis*	Avicenniaceae	'lg'
22.	Chhatralo Baval	*Acacia planifrons*	Mimosaceae	'c'
23.	Cut Gundi	*Cordia monoica*	Ehretiaceae	'g'
24.	Dudhlo	*Wrightia tinctoria*	Apocynaceae	'v'
25.	Dhaman	*Grewia tiliaefolia*	Tiliaceae	'r'
26.	Dholo Sarsado	*Albizia odoratissima*	Mimosaceae	'v'
27.	Gando Baval	*Prosopis juliflora**	Mimosaceae	'vc'&'p'

Sr. No.	Local Name	Botanical Name	Family	Incidence
28.	Garmalo	*Cassia fistula**	Caesalpiniaceae	'c'
29.	Gorad	*Acacia senegal*	Mimosaceae	'vc'
30.	Goras Amli	*Pithecellobium dulce**	Mimosaceae	'lg'
31.	Gugal	*Commiphora wightii*	Burseraceae	'vc'
32.	Gulmohar	*Delonix regia**	Caesalpiniaceae	'c'&'p'
33.	Gundi	*Cordia dichotoma*	Ephretiaceae	'c'
34.	Hermo	*Acacia leucophloea**	Mimosaceae	'c'
35.	Ingoriyo	*Balanites aegyptiaca*	Balanitaceae	'c'
36.	Jambudo	*Syzygium cumini**	Myrtaceae	'lg'
37.	Jungli Khakhro	*Erythrina suberosa*	Fabaceae	'lg'
38.	Kadayo	*Sterculia urens*	Sterculiaceae	'lg'
39.	Kalam	*Mitragyna parvifolia*	Rubiaceae	'c'
40.	Kalo Sarsado	*Albizia lebbeck**	Mimosaceae	'c'
41.	Kamai	*Albizia procera*	Mimosaceae	'c'
42.	Karanj	*Pongamia pinnata**	Fabaceae	'c'
43.	Karod	*Rhizophora conjugate**	Rhizophoraceae	'lg'
44.	Karpati	*Garuga pinnata*	Burseraceae	'c'
45.	Kasid	*Cassia siamea**	Caesalpiniaceae	'g'
46.	Kanti	*Acacia ferrugenia*	Mimosaceae	'c'
47.	Khair	*Acacia catechu*	Mimosaceae	'c'
48.	Khajuri/ Khaleranuzad	*Phoenix sylvestris*	Arecaceae	'v'
49.	Khakhro	*Butea monosperma**	Fabaceae	'vc'
50.	Kharijar	*Salvadora persica*	Salvadoraceae	'g
51.	Khijado	*Prosopis spicigera*	Mimosaceae	'c'
52.	Kunri	*Ceriops candolleans*	Rhizophoraceae	'lg'
53.	Kusum ujan	*Schleichera oleosa*	Sapindaceae	'c'
54.	Limbdo	*Azadirachta indica**	Meliaceae	'c'
55.	Mithijar	*Salvadora oleoides*	Salvadoraceae	'lg'
56.	Moledi	*Lannea coromandelica*	Anacardiaceae	'r'
57.	Narial	*Cocos nucifera**	Arecaceae	'lg'
58.	Nilgiri	*Eucalyptus hybrid*	Myrtaceae	'p'
59.	Panarv	*Erythrina variegata*	Fabaceae	'r'
60.	Paras Pipalo	*Thespesia populnea*	Malvaceae	'r'
61.	Pipalo	*Ficus religiosa**	Moraceae	'vc'
62.	Piper	*Ficus tsiela*	Moraceae	'vc'
63.	Ram baval	*Parkinsonia aculeata*	Caesalpiniaceae	'c'
64.	Rayan	*Manilkara hexandra*	Sapotaceae	'g'
65.	Ron	*Soymida febrifuga*	Meliaceae	'lg'
66.	Saledi	*Boswellia serrata*	Burseraceae	'vc'
67.	Sandesaro	*Delonix elata*	Caesalpiniaceae	'vc'
68.	Saragvo	*Moringa oleifera**	Moringaceae	'vc'
69.	Sarsado	*Albizia odoratissima*	Mimosaceae	'g'
70.	Saru	*Casuarina equisetifolia**	Casuarinaceae	'p'

Sr. No.	Local Name	Botanical Name	Family	Incidence
71.	Simlo	*Bombax ceiba**	Bombaceae	'r'
72.	Sissoo	*Dalbergia sissoo**	Caesalpiniaceae	'r'
73.	Tad	*Borassus flabellifer*	Arecaceae	'c'
74.	Timru	*Diospyros melanoxylon*	Ebenaceae	'r'
75.	Umro	*Ficus racemosa*	Moraceae	'vc'
76.	Vadlo	*Ficus bengalensis**	Moraceae	'v'
HERBS AND SHRUBS				
77.	Aghedo	*Achyranthes aspera**	Amaranthaceae	'c
78.	Ankdo Moto	*Calotropis gigantica**	Asclepiadaceae	'v'
79.	Atedi or Marda Sing	*Helicteres isora*	Sterculiaceae	'r'
80.	Ardushi	*Adhatoda vasica*	Acanthaceae	'c'
81.	Awal	*Cassia auriculata*	Caesalpiniaceae	'c'
82.	Bhindi	*Hibiscus vitifolius*	Malvaceae	'g'
83.	Bhoyringani	*Solanum suratense*	Solanaceae	'vc'
84.	Danidharia	*Lantana camara**	Verbenaceae	'v'
85.	Chanibor	*Zizyphus nummularia*	Rhamnaceae	'vc'
86.	Chini	*Tamarix stricta*	Tamaricaceae	'g'
87.	Darudi	*Argemone mexicana**	Papaveraceae	'vc'
88.	Dhaturo	*Datura metel*	Solanaceae	'vc'
89.	Dhomso	*Alhagi pseudalhagi*	Fabaceae	'lg'
90.	Dholo zipto	*Pupalia lappacea*	Amaranthaceae	'vc'
91.	Dikamali	*Gardenia resinifera*	Rubiaceae	'lg'
92.	Gadaria	*Xanthium stromarium*	Asteraceae	'lg'
93.	Gali	*Indigofera tinctoria*	Fabaceae	'c'
94.	Gabajaria	*Typha angustata**	Typhaceae	'r'
95.	Ghoda samervo	*Alysicarpus longijolius*	Fabaceae	'r'
96.	Ghokhru	*Pedalium murex*	Pedaliaceae	'vc'
97.	Gugal	*Commiphora wightii*	Burseraceae	'lg'
98.	HanthaloThor	*Opuntia elatior*	Cactaceae	'vc'
99.	Jangli Kand	*Urginea indica*	Liliaceae	'vc'
100.	Jangli Tulsi	*Ocimum americanum*	Lamiaceae	'lg'
101.	Kaner	*Thevetia peruviana**	Apocynaceae	'c'
102.	Kerdo	*Capparis deciduous*	Capparaceae	'c'
103.	Ketki	*Agave americana**	Agaveceae	'vc'
104.	Khaper	*Abutilon indicum**	Malvaceae	'c'
105.	Kharilani	*Haloxylon recurvum*	Chenopodiaceae	'lg'
106.	Kantalo thor	*Euphorbia neriifolia*	Amaranthaceae	'vc'
107.	Kharsani thor	*Euphorbia tirucalli**	Euphorbiaceae	'vc'
108.	Khip	*Leptadenia spartium*	Asclepiadaceae	'g'
109.	Kunther	*Premna obtusifolia*	Verbenaceae	'r'
110.	Kunwar	*Aloe barbadensis**	Liliaceae	'vc & p'
111.	Lano	*Cressa cretica*	Convolvulaceae	'lg'
112.	Lamdi	*Celosia argentea**	Amaranthaceae	'c'

Sr. No.	Local Name	Botanical Name	Family	Incidence
113.	Lodri	*Flacourtia occidentalis*	Flacourtiaceae	lg'
114.	Luni	*Suaeda nudiflora*	Chenopodiaceae	lg'
115.	Majith	*Dichrostachys cinerea*	Mimosaceae	'r'
116.	Mehndi	*Lawsonia inermis*	Lythraceae	'c'
117.	Mindhol	*Xeromphis spinosa*	Rubiaceae	'r'
118.	Piludi	*Solanum nigrum*	Solanaceae	'r'
119.	Tal baval	*Acacia jacquemontii*	Fabaceae	lg'
120.	Thor (Bungro)	*Euphorbia nivulia*	Euphorbiaceae	'vc'
121.	Vichhudo	*Martynia annua*	Martyniaceae	'r'
122.	Vikro	*Maytenus emarginata*	Celastraceae	'vc'
123.	Zipto	*Triumfetta rotundifolia*	Tiliaceae	'c'
CLIMBERS				
124.	Amarvel	*Cuscuta reflexa*	Convolvulaceae	'r'
125.	Boganvel	*Bougainvillea spectabilis**	Nyctaginaceae	'vc'
126.	Chanothi	*Abrus precatorius*	Fabaceae	'lg'
127.	Fagvel	*Rivea hypocrateriformis*	Convolvulaceae	'g'
128.	Galo	*Tinospora cordifolia*	Menispermaceae	'vc'
129.	Hadsankal	*Cissus quadrangularis*	Vitaceae	'vc'
130.	Kanther	*Capparis sepiaria*	Capparaceae	'r'
131.	Khirikhodi	*Leptadenia reticulata*	Asclipiadaceae	'vc'
132.	Khirvel	*Acacia pinnata*	Mimosaceae	'r'
133.	Malvel	*Combretum ovalifolium*	Combretaceae	'c'
134.	Malkankani	*Celastrus paniculata*	Celastraceae	'v'
135.	Rawal patri	*Ipomea biloba*	Convolvulaceae	'p'
136.	Satawari	*Asparagus racemosus*	Liliaceae	'g'
137.	Sankhawali	*Convolvulus microphyllus*	Convolvulaceae	lg'
138.	Vevadi	*Cocculas villosus*	Menispermaceae	'vc'
139.	Vidari	*Pueraria tuberosa*	Fabaceae	'c'
BAMBOO AND GRASSES				
140.	Baru	*Sorghum halepense*	Poaceae	'c'
141.	Bhangru	*Apluda mutica*	Poaceae	'lg'
142.	Chaklu	*Eragrostis unicloides*	Poaceae	'c'
143.	Dabh saliu	*Heteropogon contortus*	Poaceae	'lg'
144.	Darabh	*Desmostachya bipinnata*	Poaceae	'lg'
145.	Dhrafdo	*Bothriochloa glabra*	Poaceae	'vc'
146.	Dholiu	*Ischaemum rugosum*	Poaceae	'c'
147.	Dhrub	*Cynodon dactylon**	Poaceae	'lg'
148.	Gandharia	*Cymbopogon jwarancusa*	Poaceae	'r'
149.	Gandhelu	*Oplismenus burmanii*	Poaceae	'lg'
150.	Jhinjvo	*Dichanthium annulatum*	Poaceae	'vc'
151.	Katas (Vans)	*Bambusa bamboos**	Poaceae	'r'
152.	Khario	*Sporobolus coromandelianus*	Poaceae	lg'
153.	Khariu	*Dinebra retroflexa*	Poaceae	'lg'

Sr. No.	Local Name	Botanical Name	Family	Incidence
154.	Lapdu	*Aristida adscensionis*	Poaceae	'vc'
155.	Manvel (Vans)	*Dendrocalamus strictus**	Poaceae	'v '
156.	Moshti	*Iseilema prostratum*	Poaceae	'vc'
157.	Ratad	*Themeda quadrivalve*	Poaceae	'vc'
158.	Rosha	*Cymbopogon martinii*	Poaceae	'g'
159.	Shaniar	*Sehima sulcatum*	Poaceae	'vc'
160.	Sikaria	*Chloris dolichostachya*	Poaceae	'r'
161.	Zinzavo	*Bothriochloa ischaemum*	Poaceae	'c'
162.	Ziptis ghas	*Seteria glauca*	Poaceae	'r'

Abbrevation: 'p' Plantation, 'g' Gregarious, lg' Locally gregarious, 'r' Rare, 'vc' Very common, 'c' Common, 'v & r' Very rare.
Source: Working plan for Jamnagar Forest Division, Volume I, Part I & II;
***: Observed by CSIR-NEERI Team during site visit*

Table 3.5.4: List of Medicinal Plants observed

Sr. No.	Botanical Name	Common Name	Family
1.	Momordica charantia	Bitter Gourd	Cucurbitaceae
2.	Aloe barbadensis	Aloe vera	Asphodelaceae
3.	Acacia nilotica	Gum Arabic	Mimosaceae
4.	Citrus limon	Lemon	Rutaceae
5.	Ficus bengalensis	Banyan tree	Moraceae
6.	Santalum album	Sandalwood	Santalaceae
7.	Emblica officinalis	Emblica	Euphorbiaceae
8.	Asparagus racemosus	Satawari	Liliaceae
9.	Cynodon dactylon	Dhrub	Poaceae
10.	Ficus tsiela	Piper	Moraceae
11.	Acacia nilotica	Gum Arabic	Mimosaceae
12.	Aegle marmelos	Wood apple	Rutaceae
13.	Azadirachta Indica	Neem	Meliaceae
14.	Cyperus esculentus	Nut grass	Cyperaceae
15.	Terminalia arjuna	Arjun Sadad	Arjun Sadad
16.	Syzygium cumini	Jambudo	Myrtaceae
17.	Hyptis suaveolins	Wild Tulsi	Lamiaceae
18.	Lantana camara	Wild sage	Verbenaceae
19.	Tridax procumbens	Coat Buttons	Asteraceae
20.	Ziziphus mauritiana	Ber	Rhamnaceae
21.	Annona squamosa	Custard-apple	Annonaceae
22.	Murraya koenigii	Curry tree	Rutaceae
23.	Opuntia stricta	Erect prickly pear	Cactaceae

Table 3.5.5: List of Different Types of Crops Grown in Jamnagar District

Sr. No.	Common/Local Name	Scientific Name	Family
A.	**MAIN CROPS**		
1.	Cotton	Gossypium arboreum*	Malvaceae
2.	Sugarcane	Saccharum officinarum	Poaceae
B.	**CEREALS & PULSES**		
3.	Millet	Pennisetum glaucum*	Poaceae
4.	Wheat	Triticum aestivum*	Gramineae
5.	Moong	Vigna radiata	Fabaceae
6.	Tur	Cajanus cajan*	Fabaceae
7.	Urid	Vigna mungo	Fabaceae
8.	Gram	Cicer arietinum	Fabaceae
9.	Maize	Zea mays*	Poaceae
C.	**OIL SEEDS**		
10.	Groundnut	Arachis hypogaea*	Fabaceae
11.	Mustard	Brassica compestris*	Brassicaceae
12.	Til	Sesamum indicum	Pedaliaceae
13.	Castor	Ricinus communis*	Euphorbiaceae
D.	**SPICES CROPS**		
14.	Cumin	Cuminum cyminum	Apiaceae
15.	Fennel	Foeniculum vulgare	Apiaceae
16.	Dry Chillies	*Capsicum frutescens*	Solanaceae
17.	Garlic	Allium sativum	Amaryllidaceae
18.	Coriander	Coriandrum sativum	Apiaceae
19.	Ginger	Zingiber officinale	Zinziberaceae
20.	Turmeric	Curcuma longa	Zinziberaceae
21.	Fenugreek	Trigonella foenum-graecum	Fabaceae
22.	Isabgul	Plantago ovata	**Plantaginaceae**
23.	Ajwain	Trachyspermum ammi	Apiaceae
24.	Suwa	Anethum graveolens	Apiaceae
E.	**VEGETABLE CROPS**		
25.	Potato	Solanum tuberosum*	Solanaceae
26.	Onion	Allium cepa	Amaryllidaceae
27.	Brinjal	Solanum melongena*	Solanaceae

28.	Cabbage	Brassica oleracea var. capitata	Brassicaceae
29.	Okra	Abelmoschus esculentus*	Malvaceae
30.	Tomato	Solanum lycopersicum	Solanaceae
31.	Cauliflower	Brassica oleracia var. botrytis	Brassicaceae
32.	Clusterbean	Cyamopsis tetragonoloba	Fabaceae
33.	Cow pea	Vigna unguiculata	Fabaceae
F.	**CUCURBITS VEGETABLE CROPS**		
34.	Bottle gourd	Lagenaria siceraria	Cucurbitaceae
35.	Bitter gourd	Momordica charantia*	Cucurbitaceae
36.	Sweet melon	Cucumis melo var. cantalupensis	Cucurbitaceae
37.	Smooth gourd	Luffa aegyptiaca	Cucurbitaceae
38.	Ridge gourd	Luffa acutangula	Cucurbitaceae
39.	Cucumber	Cucumis sativus	Cucurbitaceae
40.	Pointed gourd	Trichosanthes dioica	Cucurbitaceae
41.	Watermelon	Citrullus lanatus	Cucurbitaceae
42.	Pumkin	Cucurbeta pepo	Cucurbitaceae
43.	Tindora	Coccinia grandis	Cucurbitaceae
44.	Valor	Dolichos lablab	Cucurbitaceae
45.	Papadi	Lablab purpureus	Cucurbitaceae
46.	Kankoda (Spiny gourd)	Momordica dioica	Cucurbitaceae
G.	**OTHER VEGETABLE CROPS**		
47.	Yam	Dioscorea alata	Dioscoreaceae
48.	Beet	Beta vulgaris	Amaranthaceae
49.	Carrot	Daucus carota	Apiaceae
50.	Sweet Potato	Ipomea batatas	Convolvulaceae
51.	Spinach	Spinacia oleracea	Amaranthaceae
52.	Radish	Raphanus sativus	Brassicaceae
53.	Mallet/Mogri	Raphanus caudatus	Brassicaceae
54.	Tandaljo	Amaranthus polygamus	Amaranthaceae
55.	Drumstick	Moringa oleifera*	Moringaceae
56.	Chilli	Capsicum annum*	Solanaceae
57.	Pea	Pisum sativum	Fabaceae
58.	Elephant foot	Amorphophallus paeoniifolius	Araceae
59.	Allocasia	Alocasia macrorrhizos	Araceae

H.	**FRUIT CROPS**		
60.	Mango	Mangifera indica*	Anacardiaceae
61.	Chickoo	Manilkara zapota*	Sapotaceae
62.	Citrus	Citrus limon*	Rutaceae
63.	Ber	Ziziphus mauritiana*	Rhamnaceae
64.	Banana	Musa paradisiaca*	Musaceae
65.	Guava	Psidium guajava*	Myrtaceae
66.	Pomegranate	Punica granatum*	Lythraceae
67.	Date palm	Phoenix dactylifera*	Arecaceae
68.	Papaya	Carica papaya*	Caricaceae
69.	Custard apple	Annona squamosa*	Annonaceae
70.	Cashew nuts	Anacardium occidentale	Anacardiaceae
71.	Amla	Phyllanthus emblica*	Phyllanthaceae
72.	Coconut	Cocos nucifera*	Arecaceae
I.	**OTHER FRUIT CROPS**		
73.	Fig	Ficus carica	Moraceae
74.	Grapes	Vitis vinifera	Vitaceae
75.	Jamun	Syzygium cumini*	Myrtaceae
76.	Mosambi	Citrus limetta	Rutaceae
77.	Tad	Borassus flabellifer*	Arecaceae
78.	Fanas	Artocarpus heterophyllus	Moraceae
79.	Tamarind	Tamarindus indica*	Fabaceae
80.	Orange	Citrus sinensis	Rutaceae
81.	Desi Badam	Terminalia catappa	Combretaceae
82.	Bijora (wild lemon)	Citrus medica	Rutaceae
83.	Wood apple	Limonia acidissima*	Rutaceae
84.	Khirni	Manilkara hexandra	Sapotaceae
85.	Bel	Aegel marmelos*	Rutaceae
86.	Falsa	Grewia asiatica	Malvaceae
87.	Gunda	Cordia dichotoma	Boraginaceae
J.	**FLOWER CROPS**		
88.	Rose	Rosa indica*	Rosaceae
89.	Marigold	Tagetes species*	Asteraceae
90.	Mogra	Jasminum sambac	Oleaceae
91.	Lily	Lilium species	Liliaceae

92.	Sevanti	Chrysanthemum species	Asteraceae
93.	Rajanigandha	*Polianthes tuberosa*	Agavaceae
94.	Coleus	*Plectranthus barbatus*	*Lamiaceae*
95.	Vijali	*Bellis perennis*	Asteraceae
96.	Gerbera	**Gerbera jamesonii**	Asteraceae

Source: Directorate of Horticulture, Jamnagar, Government of Gujarat
**: Observed by CSIR-NEERI Team during site visit*

Table 3.5.6: Area, Production and Yield Details of crops in Jamnagar District (Year 2013-2016)

Sr. No.	Name of Crop	2013-14			2014-15			2015-16		
		Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
1	Sugarcane	3.45	241.43	69980	0.85	59.81	70360	0.00	0.00	0.00
2	Total oilseeds	4064.21	11913.48	2931	1674.92	3485.81	2081	1477.90	2264.58	1532
3	Total Food Grain	792.50	2227.65	2811	137.78	152.70	1108	63.50	64.99	1024
4	Total Pulses	350.98	459.49	1309	119.66	99.63	832.61	55.06	41.19	748.16
5	Total Cereals	441.52	1768.16	4005	18.12	53.06	2929	8.44	23.80	2820
6	Total Onion	38.33	1172.88	30599	3.77	104.77	27789	2.88	77.89	27045
7	Total Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.74	1736
8	Total Sesamum	167.56	96.88	578	135.81	80.21	591	90.35	27.94	309
9	Total Groundnut	3658.25	10981.71	3002	1433.87	3158.77	2203	1296.88	2050.55	1581
10	Total Udad	35.66	23.36	655	36.29	31.65	872	15.44	8.71	564
11	Total Mung	63.78	33.92	532	46.13	23.12	501	17.99	9.02	501
12	Total Maize	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Total Rice	0.00	0.00	0.00	0.02	0.06	3210	0.00	0.00	0.00
14	Total Bajra	188.35	486.25	2582	1.48	3.88	2623	0.42	1.12	2660
15	Total Jowar	0.00	0.00	0.00	0.25	0.36	1424	0.00	0.00	0.00
Total		**9804.59**	**29405.21**	**118984**	**3608.95**	**7253.83**	**116524**	**3029.86**	**4571.53**	**40521**

Source: Directorate of Agriculture, Jamnagar, Government of Gujarat

Table 3.5.7: Area, Production & Yield of Fruit Crops of Jamnagar District (2013-14-2016-17)

Sr. No.	Crop	2013-14			2014-15			2016-17		
		Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
1.	Mango	466	2843	6.10	470	2867	6.10	424	2671	6.30
2.	Chiku	249	2822	11.33	249	2881	11.57	153	1769	11.56
3.	Citrus	249	1843	7.40	257	1904	7.41	239	2180	9.12
4.	Ber	335	3222	9.62	351	3327	9.48	180	1701	9.45
5.	Banana	29	1267	43.69	44	1936	44.00	40	1760	44.00
6.	Guava	11	48	4.36	12	52	4.33	7	30.73	4.39
7.	Pomegranate	445	3783	8.50	565	5029	8.90	527	6535	12.40
8.	Date palm	71	355	5.00	91	455	5.00	96	480	5.00
9.	Papaya	420	26087	62.11	483	30188	62.50	291	15386	52.53
10.	Custard apple	65	488	7.50	65	491	7.55	53	400	7.55
11.	Aonla	35	210	6.00	35	210	6.00	24	144	5.98
12.	Cashews Nut	4	4	1.00	4	4	1.06	0	0	0
13.	Coconut	465	418500	900	505	4247	8.41	147	1236	8.41
14.	Others	127	964	7.59	177	1389	7.85	90	661	7.34
Total		**2506**	**43934**	**17.53**	**8847**	**79170**	**8.95**	**2124**	**33617**	**15.83**

Table 3.5.8: Area, Production & Yield of Vegetable Crops of Jamnagar District (2013-14-2016-17)

Sr. No.	Name of Crop	2013-14			2014-15			2016-17		
		Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
1.	Potato	667	9309	13.96	100	1465	14.65	0	0	0
2.	Onion	4310	86200	20.00	200	4080	20.40	1000	16620	16.62
3.	Brinjal	1740	32364	18.60	1755	32468	18.50	908	17470	19.24
4.	Cabbage	690	11040	16.00	811	13657	16.84	580	9773	16.85
5.	Okra	2290	16076	7.02	2790	20088	7.20	1086	9372	8.63
6.	Tomato	2450	71050	29.00	2355	70179	29.80	845	25265	29.90
7.	Cauliflower	195	2681	13.75	97	1425	14.69	34	502	14.75
8.	Cluster Bean	4301	40860	9.50	4524	43657	9.65	565	5480	9.70
9.	Cowpea	585	4680	8.00	788	5894	7.48	318	2385	7.50
10.	Cucurbits	1660	27002	16.27	1445	23611	16.34	644	10529	16.35
11.	Others	104	1136	10.92	160	1768	11.05	147	1668	11.35
Total		**18992**	**302398**	**15.92**	**15025**	**218292**	**14.53**	**6127**	**99065**	**16.17**

Source: Directorate of Horticulture, Jamnagar, Government of Gujarat

Table 3.5.9: List of Mammals, Reptiles & Birds observed in the Study Area during July, 2018

Sr. No.	Common Name	Scientific Name	Family	Conservation Status	
				WPA (1972)	IUCN
MAMMALS					
1.	Greater Indian Fruit Bat	*Pteropus giganteus*	Pteropodidae	Schedule IV	Least concern
2.	Domestic Sheep	*Ovis sp.*	Bovidae	Schedule IV	Least concern
3.	Kankrej	*Bos sp.*	Bovidae	Schedule IV	Least concern
4.	Nilgai	*Boselaphus tragocamelus*	Bovidae	Schedule III	Least concern
5.	Wild boar	*Sus scrofa*	Suidae	Schedule III	Least concern
6.	Five-striped palm Squirrel	*Funambulus pennantii*	Sciuridae	-	Least concern
7.	Three-striped Palm Squirrel	*Funambulus palmarum*	Sciuridae	-	Least concern
8.	Indian Hare	*Lepus nigricollis*	Leporidae	Schedule IV	Least concern
9.	Rhesus Macaque	*Macaca mulatla*	**Cercopithecidae**	Schedule II	Least concern
REPTILES					
10.	Monitor Lizard	*Varanus sp.*	Varanidae	-	Least concern
11.	Fan throated Lizard	*Sitana laticeps*	Agamidae	-	Least concern
12.	Common garden Skink	*Lampropholis guichenoti*	Scincidae	-	Least concern
13.	Indian Chameleon	*Chamaeleo zeylanicus*	Chamaeleonidae	-	Least concern
BIRDS					
14.	Laughing Dove	*Spilopelia senegalensis*	Columbidae	Schedule IV	Least concern
15.	White throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae	Schedule IV	Least concern
16.	Red-vented Bulbul	*Pyconotus cafer*	Pycnonotidae	Schedule IV	Least concern
17.	Little Cormorant	*Microcarbo niger*	Phalacrocoracidae	Schedule IV	Least concern
18.	Greater Flamingo	*Phoenicopterus roseus*	Phoenicopteridae	Schedule IV	Least concern
19.	Great Blue Heron	*Ardea herodias*	Ardeidae	Schedule IV	Least concern
20.	Painted Stork	*Mycteria*	Ciconiidae	Schedule IV	Near

Sr. No.	Common Name	Scientific Name	Family	Conservation Status	
				WPA (1972)	IUCN
		leucocephala			Threatened
21.	Black winged Stilt	*Himantopus himantopus*	Recurvirostridae	Schedule IV	Least concern
22.	Black Drongo	*Dicrurus macrocercus*	Dicruridae	Schedule IV	Least concern
23.	Black hooded Oriole	*Oriolus xanthornus*	Oriolidae	Schedule IV	Least concern
24.	Rock Pigeon	*Columba livia*	Columbidae	-	Least concern
25.	Great Egret	*Ardea alba*	Ardeidae	Schedule IV	Least concern
26.	Yellow-billed Egret	*Ardea intermedia*	Ardeidae	Schedule IV	Least concern
27.	Lesser whistling Duck	*Dendrocygna javanica*	Anatidae	Schedule IV	Least concern
28.	Asian Koel	*Eudynamys scolopaceus*	Cuculidae	Schedule IV	Least concern
29.	Cattle Egret	*Bubulcus ibis*	Ardeidae	Schedule IV	Least concern
30.	Common Moorhen	*Gallinula chloropus*	Rallidae	Schedule IV	Least concern
31.	Common Myna	*Acridotheres tristis*	Sturnidae	Schedule IV	Least concern
32.	House Sparrow	*Passer domesticus*	Passeridae	Schedule IV	Least concern
33.	Oriental magpie Robin	*Copsychus saularis*	Muscicapidae	Schedule IV	Least concern
34.	Grey Patridge	*Perdix perdix*	Phasianidae	Schedule IV	Least concern
35.	Orange headed Thrush	*Geokichla citrine*	Turdidae	Schedule IV	Least concern
36.	Pond Heron	*Ardeola grayii*	Ardeidae	Schedule IV	Least concern
37.	Jungle Babbler	*Turdoides striata*	Leiothrichidae	Schedule IV	Least concern
38.	House Crow	*Corvus splendens*	Corvidae	Schedule IV	Least concern
39.	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	Schedule IV	Least concern
40.	Asian pied Starling	*Gracupica contra*	Sturnidae	Schedule IV	Least concern
41.	Indian Peafowl	*Pavo cristatus*	Phasianidae	Schedule I (Part III)	Least concern
42.	Indian Robin	*Copsychus fulicatus*	Muscicapidae	Schedule IV	Least concern
43.	Green-bee Eater	*Merops orientalis*	Meropidae	Schedule IV	Least concern

Sr. No.	Common Name	Scientific Name	Family	Conservation Status	
				WPA (1972)	IUCN
44.	Rose ringed Parakeet	*Psittacula krameri*	Psittaculidae	Schedule IV	Least concern
45.	Brahminy Starling	*Sturnia pagodarum*	Sturnidae	Schedule IV	Least concern
46.	White throated Munia	*Euodice malabarica*	Estrildidae	Schedule IV	Least concern
47.	Yellow breasted Bunting	*Emberiza aureola*	Emberizidae	Schedule IV	Least concern
48.	Ringed Plover	*Charadrius hiaticula*	Charadriidae	Schedule IV	Least concern
49.	Little Egret	*Egretta garzetta*	Ardeidae	Schedule IV	Least concern
50.	White breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	Schedule IV	Least concern
51.	Indian golden Oriole	*Oriolus kundoo*	Oriolidae	Schedule IV	Least concern
52.	Sind Sparrow	*Passer pyrrhonotus*	Passeridae	Schedule IV	Least concern

WPA: Wildlife Protection Act, 1972, IUCN: International Union for Conservation of Nature

Table 3.5.10: Common and Important Birds, Animals and Reptiles Found in the Working Plan Area, Jamnagar

Sr. No.	Common Name	Scientific Name
A - ANIMALS		
1.	Bat	*Micro chiroptera*
2.	Black Buck	*Antilope cervicapra*
3.	Caracal	*Felis caracal*
4.	Chinkara	*Gazella bennetti*
5.	Chital	*Axis axis*
6.	Common Fox	*Vulpes bengalensis*
7.	Desert Fox	*Vulpes bucopus*
8.	Desert Cat	*Felis constantina*
9.	Hare	*Lepus nigricaullis*
10.	Hyena	*Crocuta crocuta*
11.	Indian Wild Ass	*Equus hemionus khur*
12.	Jackal	*Canis laureus*
13.	Jungle Cat	*Felis chaus*
14.	Long Eared Hedge Hog	*Hemiechinus auritus*

Sr. No.	Common Name	Scientific Name
15.	Mongoose	*Herpestes auropunctatus*
16.	Common Langur	*Presbytis entellus*
17.	Nilgai (Blue bull)	*Boselaphus tragocmelus*
18.	Leopard	*Panthera pardus*
19.	Pangolin	*Manis carassicaudato*
20.	Porcupine	*Hystix indica*
21.	Squirrel	*Funambulus pennati*
22.	Wild Boar	*Sus scrofa*
23.	Wolf	*Canis lupus*
B – REPTILES		
1.	Crocodile	*Crocodylus palustris*
2.	Monitor Lizard	*Varanus bengalensis*
3.	Python	*Python molurus*
4.	Star Tortoise	*Geochelone elegans*
	Water Monitor	*Varanus salvator*
C - BIRD		
1.	Little Grebe	*Podiceps ruficollis*
2.	Rosy Pelican	*Pelecanus onocrotalus*
3.	Large Cormorant	*Phalacrocorax qarbo*
4.	Little Cormorant	*Phalacrocorax niger*
5.	Darter	*Anhinga rufa*
6.	Grey Heron	*Ardea cinerea*
7.	Large Egret	*Ardea alba*
8.	Pond Heron	*Ardeola grayii*
9.	Cattle Egret	*Bubulcus ibis*
10.	Little Egret	*Egreta garzetta*
11.	Reef Heron	*Egreta gularis*
12.	Painted Stork	*Mycteria leucorodia*
13.	White Ibis	*Threskiornis aethiopica*
14.	Black Ibis	*Pseudibis papillosa*
15.	The Spoonbill	*Platalea leucorodia*
16.	The Flamingo	*Phoenicopterus roseus*
17.	Shoveler Duck	*Anas clypeatea*
18.	Black winged Kite	*Elanus caeruleus*

Sr. No.	Common Name	Scientific Name
19.	Brahminy Kite	*Haliastur indus*
20.	The Shikara	*Accipiter badius*
21.	White backed Vulture	*Gyps bengalensis*
22.	White Scavenger Vulture	*Neophron percnopterus*
23.	Marsh Harrier	*Circus aeruginosus*
24.	Osprey	*Pandion haliaetus*
25.	Grey Partridge	*Francolinus pondicerianus*
26.	The Jungle Bush Quail	*Perdicula asiatica*
27.	Common Peafowl	*Pavo cristatus*
28.	The Demoiselle Crane	*Anthropoides virgo*
29.	The Great Indian Bustard	*Choriotis nigriceps*
30.	Hobara Bustard	*Chlamydotis undulate*
31.	Lesser Florican	*Sypheotides indica*
32.	Pheasant tailed Jacana	*Hydrophasianus spp*
33.	Red wattled Lapwing	*Vanellus indicus*
34.	Grey Plover	*Pluvialis squatarola*
35.	Curlew	*Numenius arquata*
36.	Black tailed Godwit	*Limosa limosa*
37.	Bar tailed Godwit	*Limosa lapponica*
38.	Redshank	*Tringa totanus*
39.	Black winged Stilt	*Himantopus himantopus*
40.	Avocet	*Recurvirostra avosctta*
41.	Herring Gull	*Larus argentatus*
42.	River Tern	*Sterna aurantia*
43.	Blue Rock Pigeon	*Columba livia neglecta*
44.	Ring Dove	*Streptopelia decaocto*
45.	Little Brown Dove	*Strebopelia senegalensis*
46.	The Roseringed Parakeet	*Psittacula krameri*
47.	Black Drango	*Dicrurus adsimillis*
48.	Bank Myna	*Acridotheres ginginianus*
49.	Brahminy Myna	*Sturnus pagodarum*
50.	Common Myna	*Acridotheres tristis*
51.	House Crow	*Corvus splendens*
52.	Jungle Crow	*Corvus macrorhynchos*

Sr. No.	Common Name	Scientific Name
53.	Rufous backed Shrike	*Lanius schach*
54.	Common Wood Shrike	*Tephrodornis pondicerianus*
55.	Rosy Pastor	*Sturnus roseus*
56.	Pied Crested Cuckoo	*Clamator jacobinus*
57.	Koel	*Eudynamys scolopacea*
58.	Spotted Owlet	*Athene brama*
59.	The Palm Swift	*Cypsiurus parvus*
60.	Small Blue Kingfisher	*Allcedo atthis*
61.	Pied Kingfhisher	*Ceryle rudis*
62.	Indian Roller	*Coracias bengalensis*
63.	Blue Rock Thrush	*Monticola gularis*
64.	Crested Lark	*Galerida deva*
65.	The Jungle Babbler	*Turdoides striatus*
66.	Tailor Bird	*Orthotomus sutorius*
67.	Indian Robin	*Saxicoloides fulicata*
68.	Great Tit	*Parus major*
69.	Grey Wagtail	*Motacilla cinerea*
70.	White Wagtail	*Motacilla alba dukhuensis*
71.	Purple Sunbird	*Nectarinia asiofica brevirostris*

Source: Working plan for Jamnagar Forest Division, Volume I, Part I & II

Table 3.5.11: List of Insects observed in the Study Area during July, 2018

Sr. No.	Common Name	Scientific Name	Family
Beetles & Bees			
1.	Salt water snail	*Gastropod species*	Gastropoda
2.	Ditch jewel	*Brachythemis contaminata*	Libellulidae
3.	Marsh hawk	*Orthetrum sabina*	Libellulidae
4.	Golden winged skimmer	*Libellula auripennis*	Libellulidae
5.	Red stink bug	*Melanphaus sp.*	Pentatomidae
6.	Housefly	*Musca domestica*	Muscidae
7.	Indian honeybee	*Apis cerana indica*	Apidae
8.	Roseate skimmer	*Orthemis ferruginea*	Libellulidae
9.	Common green grasshopper	*Omocestus viridulus*	Acrididae
10.	Robber fly	Varies sp.	Asilidae
11.	Blister beetle	Mylabris pustulata	Meloidae
12.	Water strider	Aquarius *species*	Gerridae
13.	Bumble bee	Bombus *species*	Apidae
14.	Clover mite	Bryobia praetiosa	Tetranychidae
Butterflies and Moth			
15.	Plain tiger	*Danaus chrysippus*	Nymphalidae
16.	Swallow tail butterfly	*Papilio demoleus*	Papilionidae
17.	Common grass yellow	*Eurema hecabe*	Pieridae
18.	Common crow	*Euploca core*	Nymphalidae
19.	Common buckeye	Junonia coenia	Nymphalidae
20.	Rufous minor	Oligia sp.	Noctuidae
21.	Common windmill	*Byasa polyeuctes*	Papilionidae

Table 3.5.12: Common Fishes found in Jamnagar District

Sr. No.	Common Name	Scientific Name
1.	White Pomfret	*Pampus argenteus*
2.	Black Pomfret	*Parastromateus niger*
3.	Bombay Duck	*Harpadon nehereus*
4.	Thread Fin	*Eleutheronema tetradactylum*
5.	Jew Fish	*Argyrosomus japonicus*
6.	Hilsa	*Tenualosa ilisha*
7.	Other Clupeids	*Clupea species*
8.	Catla	*Labeo catla*
9.	Shark	*Carcharodon species*
10.	Mullet	*Mugil species*
11.	Cat Fish	*Ancharius species*
12.	Eel	*Electrophorus electricus*
13.	Leather Jacket	*Oligoplites saurus*
14.	Seer Fish	*Cybium species*
15.	Indian Salmon	*Eleutheronema tetradactylum*
16.	Ribbon Fish	*Lepturacanthus saval*
17.	Silver Bar	*Chirocentrus dorab*
18.	Perchlet	*Ambassis commersoni*
19.	Prawns (Medium)	*Fenneropenaeus indicus*
20.	Prwans (Jumbo)	*Penaeus monodon*
21.	Lobster	*Panulirus species*
22.	Crabs	*Portunus pelagicus*
23.	Levta	*Neochanna diversus*
24.	Squid Fish	*Loligo duvaucelii*
25.	Tuna	*Thunnus species*
26.	Macarel	*Rastrelliger kanagurta*
27.	Sole	*Cynoglossus macrolepidotus*

Source: Commissionerate of Fisheries, Gujarat State, Working Sheet A, Jamnagar

Table 3.5.13: List of Flora within the Nayara Refinery

Sr.No.	Plant Species	Sr.No.	Plant Species
TREES			
1.	Mangifera indica Var.KESAR (Mango)	28.	Areca palm
2.	Casurina equisetifolia (Saru)	29.	Thevetia
3.	Punica Granatum (Pomegranate)	30.	Cesalpinnia
4.	Acharas sapota (Chiku)	31.	Biksa (Sindur)
5.	Acacia auriculiformis (Australian Babul)	32.	Pandanus
6.	Pongamia glabra (Karanj)	33.	Ficus green
7.	Azadirachta Indica (Neem)	34.	Ficus Panda
8.	Peltophorum pterocarpum (Sonmohar)	35.	Kerala Hybrid
9.	Royal poinciana (Gulmohar)	36.	Datepalm
10.	Samanea saman (Rain Tree)	37.	Custard apple
11.	Tabubiya	38.	Bullock heart/RamPhal
12.	Alstonia scholaris (Saptparni)	39.	Dragon fruit
13.	Bauhinia Species	40.	Rose apple
14.	Bauhinia purpurea (Bauhinia)	41.	Setur (Mulberry)
15.	Tamarindus indica (Ambali)	42.	Kamrak (Star Fruit)
16.	Pithecellobium dulce (Goras Ambli)	43.	Rayan
17.	Terminalia catappa (Indian Almond)	44.	Peltophorum
18.	Moringa oleifera (Drumstick)	45.	Plumeria
19.	Cassia fistula (Garmalo)	46.	Paras Pipal
20.	Ficus benghalensis (Banyan Tree)	47.	Lemon
21.	Ficus carica (Fig)	48.	Lychee
22.	Ficus racemosa (Umbaro)	49.	Star apple
23.	Cocos nucifera (Coconut tree)	50.	Papya plant
24.	Roystonea regia (Royal plam)	51.	Anthurium
25.	Washingtonia robusta	52.	Petunia
26.	Nyctanthes arbor (Parijatak)	53.	Cycus revoluta
27.	Christmas tree		
SHRUBS			
1.	Cassia siamia	24.	Desi Mehndi
2.	Rosa species /Rose	25.	Green Mehndi
3.	Hibiscus speices	26.	Acalypha Godrej
4.	Dracena fragrans green (Corn Plant)	27.	Croton (Propagated)
5.	Dracaena deremensis (Dwarf Bouquet)	28.	Croton (Purchased)
6.	Adenium species	29.	Erynthimun
7.	Russelia equisetiformis/Russelia	30.	Coleus
8.	Bromeliads	31.	Snowbush
9.	Yucca	32.	Tapioca
10.	Ixora	33.	Passion Flower
11.	Ixora Dwarf	34.	Lantana
12.	Revenia	35.	Coffee
13.	Russelia Red	36.	Pedilanthus

14.	Russelia white	37.	Cordia
15.	Largestomia	38.	Tecoma gaudichaudi
16.	Bougainvellia Pharmosa	39.	Tecoma speices
17.	Bougainvelllia white	40.	Acalypha speices
18.	Bougainvelllia Tometo color	41.	Euphorbia species
19.	Bougainvelllia red	42.	Gazania
20.	Neerium	43.	Merigold
21.	Kufia	44.	Coleus
22.	Green Tea	45.	Conocarpus
23.	Golden Duranta	46.	Leucophyllum
HERBS			
1.	Jasminum auriculatum (Juhi)	21.	Senseveria /Snake plant
2.	Jasminum elongatum (Red Kunda)	22.	Agave speices
3.	Dieffenbechia	23.	Jade plant
4.	Amaryllis Lily	24.	Philodendron yellow
5.	Bhrama Kamal (Epiphyllum oxypetalum)	25.	Heliconia
6.	Football lily	26.	Football lily
7.	Euphorbia geraldii	27.	Lilly
8.	Euphorbia milli var. splendens	28.	Amaryllis lily
9.	Asparagus densiflorus meyerii	29.	Syngonium
10.	Asparagus densiflorus compacta	30.	Mint
11.	Adiantum capillus-veneris (Common Maidenhair Fern)	31.	Laal Bhaji (Alternanthera)
12.	Pentas lanceolata hybrida	32.	Tulsi
13.	Cestrum noctrum (Raat Rani)	33.	Papermint
14.	Poinsetia Euphorbia pulcherima	34.	Vincca
15.	Arelia species	35.	Chrysenthemum
16.	Money Plant	36.	Musa speices
17.	Phylodendron	37.	Cardamom
18.	Aglonima	38.	Pineapple speices
19.	Arabian jasmine/Mogra	39.	Red Ginger
20.	Dracaena speices	40.	Torch Ginger
SUCCULENTS		**OTHERS**	
1.	Agave	1.	Alamanda
2.	Furcerea	2.	Parda vel
3.	Alovera	3.	Wedelia
4.	Cactus	4.	Rangoon creeper
5.	Agave	5.	Aspragus setaceus (Lacy Asparagus Fern)

3.6 Socio-economic Environment

3.6.1 Baseline Status

The study of socio-economic component of environment incorporates various facets, viz. demographic structure, availability of basic amenities such as housing, education, health and medical services, occupation, water supply, sanitation, communication and power supply, prevailing diseases in the region as well as features such as places of tourist attraction and monuments of archaeological importance. The study of these parameters helps in identifying, predicting and evaluating the likely impacts due to project activity in the surrounding region. The following aspects have been covered in the study on socio-economic component:

- Administrative Setup
- Demographic Structure
- Infrastructure Base In The Area
- Economic Structure
- Health Status
- Cultural Attributes
- Socio-Economic status in relation to Quality of Life and public awareness & public concern about the project.

Secondary data was collected from various sources like census records, primary health centres, official records etc., whereas primary data was collected through field surveys and interacting with different representative groups in the study area. Information on socio-economic profile was collected from the Primary Census Abstract CD 2011, including the population details of the region and Village Directory CD 2011, having village wise details of basic amenities available in the region.

3.6.1.1 Administrative Setup

The 10 km radius study area around Nayara Refinery lays under two districts; Jamnagar and Devbhumi Dwarka. The Devbhumi Dwarka district was carved out of the Jamnagar district on August 15, 2013. Prior to this, the entire refinery complex was under Jamnagar district. Twenty-five villages in the study area come under three tehsils, namely Lalpur tehsil in Jamnagar (12 villages), Khambhalia tehsil in Devbhumi Dwarka (11 villages) and Jamnagar Tehsil (2 villages).

Geographical map of Jamnagar district along with Devbhumi Dwarka district where Nayara Refinery is located is shown in **Fig. 3.6.1**. Further, administrative setup/map showing location of Nayara Energy with surrounding villages is shown in **Fig. 3.6.2**.

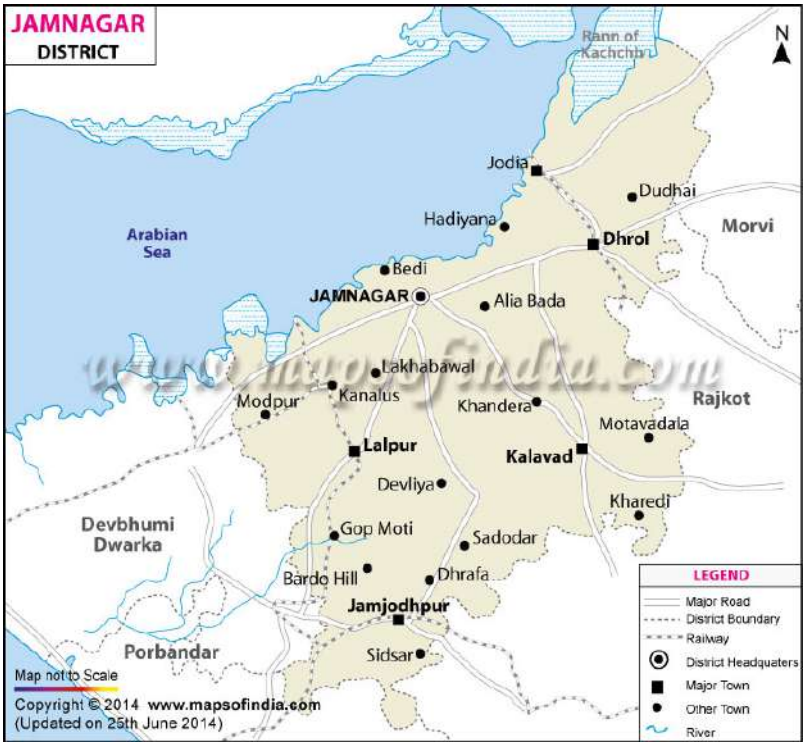


Fig. 3.6.1: Geographical Setup around Nayara Refinery in Jamnagar and Devbhumi Dwarka Districts

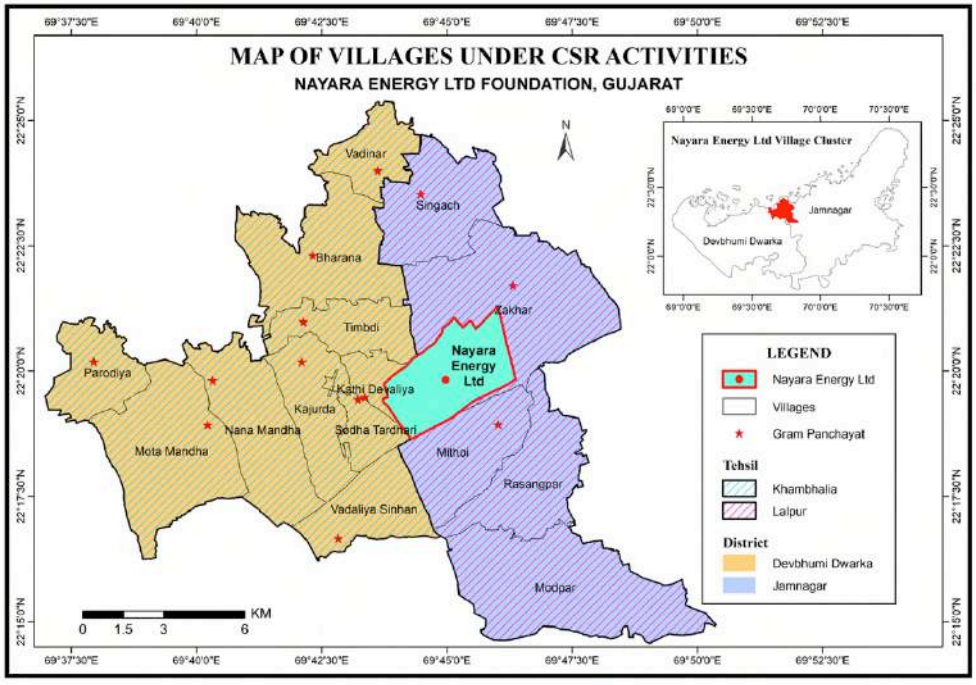


Fig. 3.6.2: Administrative Setup – Location of Nayara Refinery with Surrounding Villages

3.6.1.2 Demographic Data Analysis

Demographic data of the 25 villages under three tehsils (Lalpur, Khambhalia and Jamnagar) falling under the study region was collected from the Primary Census Abstract of Jamnagar district for the year 2011.

Demographic details such as number of households, total area, population, male, female, population density, sex ratio, SC and ST population, and literacy rate and employment pattern were collected tehsil-wise for each of the villages.

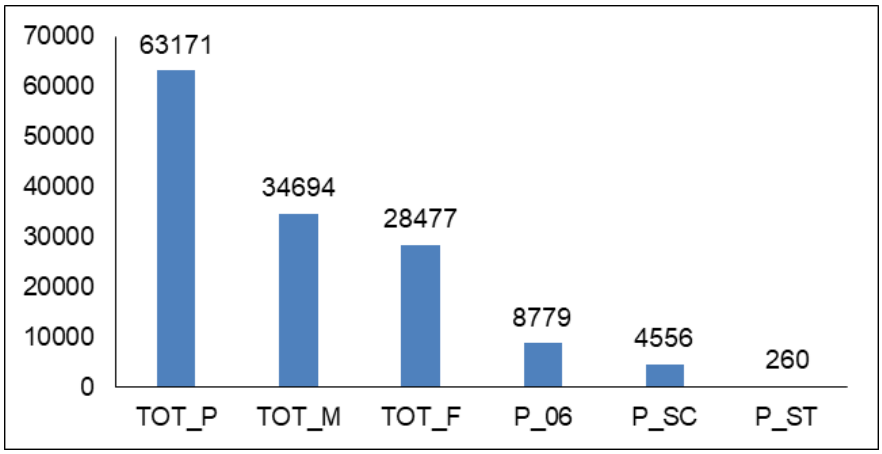
Tehsil-wise demographic details are summarized in **Table 3.6.1**.

Further, village wise details of population structure, literacy status, employment pattern, main workers employment pattern are given in **Tables 3.6.2 to 3.6.5**, respectively. The salient observations are given here.

Population Structure

- As per 2011 Census, total population of the study area was 63171, out of which male population was 34694 (54.92%) and female population was 28477 (45.08%)
- Total number of households were 12081 with average occupancy of 5.23 persons per household
- Total geographical area of the study area was 290.48 km^2 with population density of 217 persons/km^2
- Total child population (below 6 years of age) was 8779 (13.90%)
- Total SC population was 4556 (7.21%), and ST population was only 260 (0.41%) in the study area
- Sex ratio (number of females/1000 males) of the total population was 821.

Population structure of the study area is presented in **Fig. 3.6.3**.



Y-axis – Population in Numbers

Fig. 3.6.3: Population Structure of the Study Area

Literacy Status

- Overall literate population was 36546 (57.85%) and illiterate population was 26625 (42.15%)
- Out of total literates, male literates were 23182 (63.43%) and female literates were 13364 (36.57%)
- Out of total illiterates, male illiterates were 11512 (43.24%) and female illiterates were 15113 (56.76%)

Employment Pattern

Economic resource base of any region mainly depends upon its economically active group i.e. the working population involved in productive work. Work may be defined as participation in any economically productive activity. Such participation may be physical or mental in nature. Work not only involves actual work but also effective supervision and direction of work. It also includes unpaid work on farm or in family enterprise.

There are different types of workers that may be classified as - those persons who had worked for at least six months or 183 days, are treated to be Main Workers, on the other hand if person categorized as worker has participated in any economic or productive activity for less than six months or 183 days during the last one year, is treated as Marginal Worker. Non–workers are those who have not worked any time at all in the year preceding the enumeration.

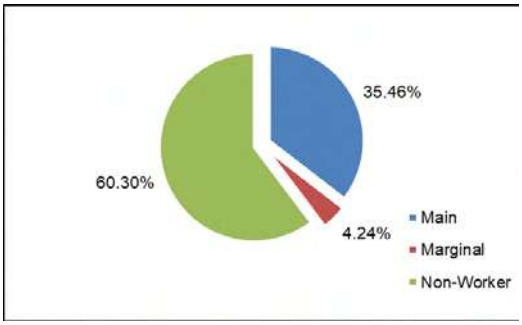
The workers coming under the main and marginal workers category are those involved in activities such as cultivation, agriculture, livestock, forestry, fishing, hunting, plantations, orchards and allied activities, mining and quarrying, manufacturing, processing, servicing and repairs in household industry, construction, trade and commerce, transport, storage and communication and other services.

- According to 2011 Census, total population of workers in the study area was 25079 (39.70%).
- Main and marginal workers were 22400 and 2679 respectively, which is 35.46% and 4.24% of the total population. Total non-working population was 38092 (60.30%**)**

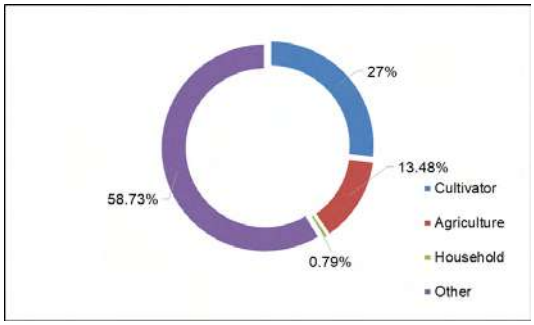
Main Workers Employment Pattern

Main workers are classified in four categories as cultivators, agricultural workers, household industry workers and other workers. As per 2011 Census, Out of total 22400 main workers in the study area, there were total 6047 cultivators (27%), 3019 agricultural workers (13.48%), 178 household industry workers (0.79%) and other workers 13156 (58.73%).

Employment status and distribution of main workers is shown graphically in **Fig. 3.6.4.**



Main, Marginal & Non-Workers



Distribution of Main Workers

Fig. 3.6.4: Employment Status and Distribution of Main Workers

3.6.1.3 Infrastructure Resource Base – Basic Amenities

The infrastructure resources base of the study area with reference to education, medical facility, water supply, post and telegraph, transportation, communication facility, power supply and existence of nearest town etc. according to the Village Directory Census CD 2011 was analysed. The significant features of these important parameters for each study area are presented here.

Education

As per 2011 village directory record, almost all villages having education facility in the form of primary schools and middle school are as follows:

Govt. Primary School	Private Primary School	Govt. Secondary School	Private Senior Secondary School
45	6	4	1

Medical/Primary Community Health Care

Medical facilities in terms of community health centres are available in some of the villages. Only primary health sub centres are available in few villages.

Community Health Centre	Primary Health Centre	Primary Health Sub Centre	Maternity And Child Welfare Centre	Hospital Allopathic	Veterinary Hospital
1 (Zankhar village operated by Nayara Refinery)	1 (Modpar village)	2 (Singach & Bharana villlage)	0	1 (Vadinar village)	1 (Padana village operated by Reliance)

Drinking Water

The water supply in the region is through dug wells, hand pumps, taps and other allied sources.

Tap Water Untreated	Covered Well	Uncovered Well	Hand Pump	Tube Wells /Borehole	River/Canal	Tank/ Pond/ Lake
25	2	22	22	17	18	5

Drainage and Sanitation Facilities

Drainage and sanitation facilities were not adequate in the study area. Mostly open drainage, and open kuccha drainage observed in the village.

Closed Drainage	Open Drainage	No Drainage	Open Pucca Drainage Uncovered	Open Kuccha Drainage
1	12	12	5	7

Communication

Communication facility is fairly good in the region. Near about 50% villages are having telephone connectivity and have post offices.

Post Office	Sub Post Office	Telephone (landlines)	Public Call Office /Mobile (PCO)
1	12	25	16

Transportation

A well planned and efficient network of transport is an essential for economic growth of any region. Transport facilities available in the region are as follows:

Public Bus Service	Private Bus Service	Railway Station	Auto/Modified Autos	Taxi	Vans	Tractors
25	2	2	8	2	3	14

Road Approach

Roads are the basic means of communication for the development of any economy. All type of roads were present in the study area.

Black Topped (pucca) Road	Gravel (kuchha) Roads	Water Bounded Macadam	All Weather Road	Footpath
25	8	5	24	25

Bank Facilities

Banking and agricultural credit society facility was found in some villages. Self help group activities were performed by the women groups.

ATM	Commercial Bank	Cooperative Bank	Agricultural Credit Societies	Self - Help Group (SHG)
1	2	0	18	40

Power Supply

Almost all villages are electrified in the region and electricity is available for both domestic and agriculture.

Power Supply For Domestic Use	Power Supply For Agriculture Use	Power Supply For Commercial Use	Power Supply For All Users
25	25	25	25

Source: District Census Handbook 2011, Gujarat State

The above statistics are based on 2011 Census records. Present situation in the region is much better in terms of all the facilities required for the people of the region.

3.6.2 Socio-Economic Survey

3.6.2.1 Methodology

In order to access and evaluate likely impacts arising out of any development projects on socio-economic environment, it is necessary to gauge the apprehensions of the people in the study area.

A judgmental and purposive sampling method was used for choosing respondents of various sections of the society i.e. Sarpanch, adult males and females, teachers, medical practitioners, businessmen, agriculture labourers, unemployed group etc. Field survey and observations is made at each sampling village and the socio-economic status of that region is studied. Visits were made at hospitals, primary health centres and sub-centres to know the health status of the region.

Structured interview method was used to collect data regarding the awareness and opinion from the samples selected of the various socio- economic sections of the community. Structured interviews involve the use of a set of predetermined questions that includes fixed and alternative questions. The questionnaire mainly highlights the parameters such as income, employment and working conditions, housing, food, water supply, sanitation, health, energy, transportation and communication, education, environment and pollution to assess the standard of living of that particular region and

general awareness, opinion and expectation of the respondents about the proposed project. Interview method helps to collect more correct and accurate information as the interviewer is present during the field survey.

The respondents were asked for their awareness / opinion about the existing plant and also of their opinion about the positive and negative impacts of the plant activities viz. job opportunities, education, health care, housing, transportation facility and economic status etc.

Socio-economic survey was conducted during July 2-5, 2018. The villages were selected randomly, four each from Lalpur tehsil (Zankhar, Mithoi, Rasangpar & Modpar) and Khambhalia tehsil (Nana Mandha, Vadinar, Bharana & Khajurda village). Location of villages surveyed is depicted in **Fig. 3.6.5.**

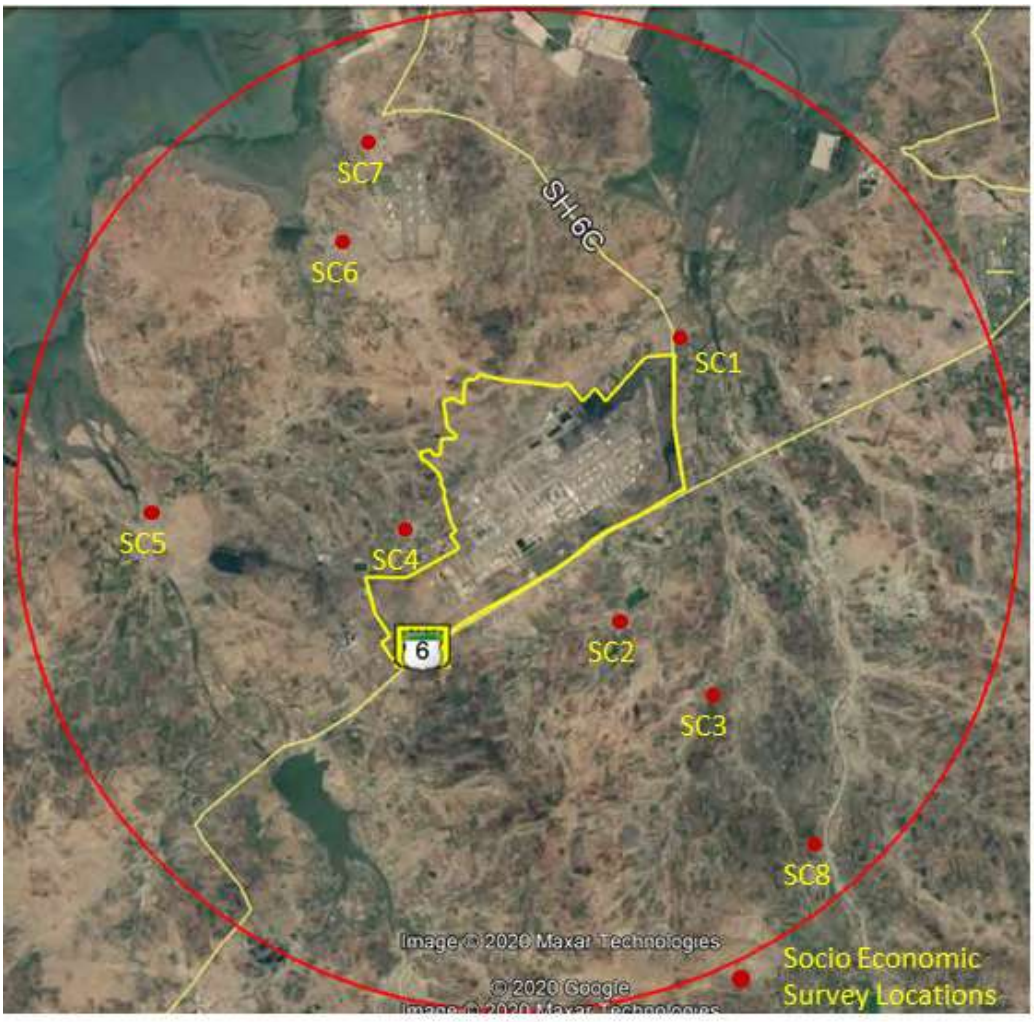


Fig. 3.6.5: Map Showing Villages Surveyed for Socio-economic Study

Level of consultation with different groups was as given under:

Level	Type	Key participants
Individual	Household survey	People including those are impacted directly or indirectly
Settlement	Focused Group Discussions (FGD)	Villagers and Village Leader, Fishermen Community etc.
Govt. office	Discussion	Gram Panchyat Sarpanch, Gram Panchyat Secretary

Salient observations of the survey conducted are given here.

3.6.2.2 Salient Observation based on Survey Conducted

- **House pattern:** Quality of houses is in well condition and most of the people have permanent cemented (pucca) constructed houses few villagers are having kaccha houses as well.
- **Employment**: Most of the population is engaged in port related labour work, in GIDC near Jamnagar. There are many companies nearby which are providing labour work and permanent job also. Some population is engaged in business activities such as land dealer, fishing, shops etc. Peoples having their own land are engaged in farming in a rainy season. The district mainly produces Cotton, Groundnut and Wheat, but because of insufficient irrigation facility farmers get only one season crop in a year. Fishing activities are carried out by the number of fishermen. The labours were getting daily wage in the range of Rs. 200-250, depending on type of work involved.
- **Fuel:** Most of the villagers use fire-woods and LPG for cooking purpose.
- **Language:** The main language/mother tongue of the people in the district is Gujarati, and people also speak Hindi.
- **Migration:** During the survey, it was found that local population are migrating for employment purpose to other districts/states, and at the same time many people are coming from other states also for employment.
- **Sanitation:** Sanitation facilities are in good condition, 60% villagers are using toilets. It shows that villagers are aware about sanitation. Some villages, which are near some companies, their population is increasing day by day due to migration of labor from other states. They are living in any unsettled condition and do not have sufficient facility because of shortage of space for their daily needs, and therefore creating unhygienic conditions.
- **Drinking Water Facilities:** Many initiatives have also been taken by Nayara Energy for water resource development such as Check Dams in Singach, Pond Reclamation in Zankhar, Borewell recharge, Check Dams in Bharana, drinking water pipelines from Salaya to Parodiya. Nayara Energy also

collaborated with local communities to construct and repair water-harvesting structure.

- **Education Facilities:** Anganwadi Centres are available in most of the villages. The survey data indicated that most of the villages are having primary school facility while for further education people have to travel about 40 km. Highest educational level in the study area is up to 10th class. The scope for higher and technical education exists only at the district place and only few people are able to take benefits of these educational institutions.
- **Road Connectivity & Transportation Facility:** Approach roads are mainly cemented roads. Bus services and other private sources for transportation are available for villagers; Roads are well connected with main district. Villagers who are deprived from transportation facility in their village, they have to walk down 1 to 3 km.
- **Communication Facilities:** Communication facility is good in the study area. Every villager is having mobile phone, television, and newspaper facility. It indicates that the study area is well developed in communication.
- **Medical Facilities:** Most of the village residents have to travel an approximate distance of 5-15 km to get medical facilities at tehsil place, as there is no such facility available of PHC/CHC. Company has been implementing a community health project in 15 villages through Mobile health Van and support of Ambulances. There is a Health Centre at Jhakhar village, which is operational 24X7. During the site visit it was understood through public consultation with stakeholders that Anganwadi and ASHA workers are available in most of the villages of the study area. There are no chronic or epidemic diseases reported/or observed during the course of site visit of the study area except general cases of fever and cough.
- **Electricity:** Electricity is available in almost all the villages, however most of the villages are having only for domestic and other purposes.
- **Market Facility:** Study area was predominantly semi urban type. In villages, small shops were available for daily needs. Weekly market facility was available in some villages. Wholesale markets were available at town place.

On the basis of interpretation made above, primary survey (interaction with stakeholders, FGD, community consultation and discussion with influential persons of the study area) and secondary sources.

Livelihood of most of the people of the study area depends on jobs, fishing, fishing allied, Agriculture, and cattle rearing. Tap water and Hand pump are the source of drinking water in the study area. No chronic or epidemic disease has been reported in the study area except general cases of cough and fever, however, sanitation and drainage system is very poor in the study area. Approx. 80% area has no drainage system in the study area.

Public interaction photographs are given in **Plate 3.6.1**.

3.6.2.3 Awareness and Opinion of People about the Project

An attempt has been made to know the awareness and opinion of the people about Nayara Energy Limited.

- Most of the respondents were aware about the Nayara Energy Limited.
- The respondents were happy to know about the project and they opined positively because any industrial development activity would definitely contribute to development towards improvement in the local as well as regional economy and creation of job opportunities
- Respondent asked for better health services and better transportation facilities
- Youths from nearby villages are also getting job opportunities for labour and transportation work by the company and they are satisfied with their earning
- Local Fishermen asked for the training and knowledge for the fishing activity at the coastal belt so that they can get more productivity.

Interaction with different village Sarpanch/Society Heads/ villagers was done to understand the socio-economic issues of the region and their needs. Details of the interactions and major issues identified are summarized in **Table 3.6.6**, and are briefly described here.

Consultation with Fisherman Community

Fisherman Community mostly resides in the areas closer to the port. The main source of livelihood of the community is fishing and fishing allied activities only. During the course of interaction with the community, it has been observed that they are seeking for the health and hygiene facilities as a basic need of daily living. Unavailability of water is the main concern of people. There are limited source of water available within the village and the quality of drinking water is not good for their health also.

Another high risk identified is about non-availability of fishes in the mouth zone, due to breakwater. People go deep for fishing, and may end up causing a fatal accident due to swirling waves. It was explained by one of the victims of the hazards.

Consultation with Women

Study team consulted different women groups and asked them about their education, employment opportunity, health and position in the society. In addition to their household works, their secondary involvement is limited to agricultural works, which is seasonal in nature. They are comparatively less educated with respect to male and have limited opportunity of employment but they are aware about their rights.

Consultation with Youth of the Study Area

A consultation was conducted with youths to record their perception and the opinion about the project. Study team discussed the developmental issues and employment opportunity in the region. It is observed that youth in the study area are much conscious with their education, career and also seeking employment opportunities in proposed project

3.6.3 Quality of Life Assessment

Quality of life (QoL) indicates overall status of socio-economic aspects in a given area. Quality of life (QoL) is defined as a function between "objective conditions" and "subjective attitudes" involving a defined "area" of concern.

The "objective conditions" are numerically measurable artefacts of a physical, sociological event or economic event. Objective conditions may be defined as any number, which stands for a given quantity of a variable of interest so long as it is independent of subjective opinion.

Subjective attitude" is primarily concerned with effective and cognitive dimensions. It is specifically concerned with 'how aspects of cognition vary as objective conditions vary'.

Once objective measures are obtained for each factor they are transformed to a normal scale varying from 0 to 1 (value function curve) in which 0 corresponds to the lowest or least satisfactory measure, and 1 corresponds to the highest. The weights are assigned to each factor by ranked-pair wise technique (by the expert group) based on the secondary data and general observations.

For each objective measure, a corresponding subjective measure is developed for each individual of the sample population by asking him to rate his satisfaction scale (value function curve). It is used such that 0 corresponds to the lowest level of attitudinal satisfaction and 1 corresponds to the highest level of satisfaction. Weights are assigned to each factor using ranked - pair wise comparison techniques.

The socio-economic indicators used for computation of QoL are:

• Employment	• Housing
• Income	• Health
• Transportation	• Recreation
• Education	• Agriculture
• Medical Facilities	• Cost of Living
• Communication	• Business
• Power	• Per Capita Income
• Sanitation	• Pollution

Subjective, objective and cumulative quality of life is estimated as:

(I) Subjective QoL Calculations:

$$QoLs = 1/p \sum_{i=1} \sum_{j=1} QIij \times Wi$$

Where,

QoLs= Subjective quality of life index

p= No. of respondents, j = 1, p

m = No. of factors, i = 1, m

QIij= Subjective quality index for ith factor assigned by jth respondent

$\sum$ Qiij = Subjective quality index for ith factor assigned by all respondents in an area

Wi = Relative weightage of the ith factor

(II) Objective Quality of Life

$$QoLo = \sum_{i=1}^{i=n} QIi \times Wi$$

Where,

QoLo = Objective quality of life index

n = No. of QoL Factors

i = 1, n

QIi = Satisfaction level (assigned by the expert group) for the ith objective indicator

Wi = Normalized weight for its factor

(II) Quality of Life (Cumulative Index)

$$QoLc = \frac{QoLo + QoLs}{2}$$

The subjective and objective QoL indices estimated for the present status in different villages are presented in **Table 3.6.7**.

The average QoL index values are estimated as:

QoL (s) = 0.51

QoL (o) = 0.53

QoL (c) = 0.52

The average QoL index value for the study area is satisfactory due to facilities like, educational facilities, roads, also availability of basic needs viz., food, clothing & housing. Medical and communication facilities were not adequate in the study area;

Improvement in these fields will help to increase quality of life of the people in study area.

3.6.4 CSR Initiatives by Nayara Energy Limited

Nayara Energy Limited is an independent oil company with strong presence across the hydrocarbon value chain from refining to retail. The Company has 20 MMTPA refinery situated at Vadinar, District Devbhumi Dwarka in Gujarat, India. The refinery is supported by captive port, storage facilities and a thermal power plant.

At Nayara Energy, Corporate Social Responsibility (CSR) has been an integral part of its business strategy. Nayara Energy appreciates the social and economic diversity in the Country and has consciously embedded the community engagement dimension in its business planning, risk and reputation management processes. The CSR initiatives of Nayara Energy have played a pivotal role in improving the quality of life of the communities living in the vicinity of operations of the Company.

3.6.4.1 Vision, Mission and Objectives

Nayara Energy's vision is to be among the most respected organizations in India by doing what is right and rightful for the communities and nation at large.

Nayara Energy aspires to build a symbiotic relationship with its stakeholders and intends to make them equal partners in the process of nation building. We firmly believe that our role is to lay the path that is collaborative, progressive, inclusive and sustainable through our CSR programs. It also believes that technology and innovations can hasten the process of change and endeavour to support new and innovative models of development.

The objective of the CSR policy is to guide the planning, implementation and oversight mechanism of the CSR programs of Nayara Energy.

3.6.4.2 CSR Strategy

The CSR strategy of Nayara Energy shall be to

- Focus on immediate community and stakeholders around the refinery, terminals, depots and retail outlets.
- Develop thought leadership in social development and promote forums that widen the sphere of impact and knowledge.
- Promote use of technology, innovative ideas and new tools that support community development and nation building.
- Foster partnerships with national/ international institutions, NGOs, companies, civil society organizations and government organizations to further the cause of communities
- Support national agenda on development

3.6.4.3 CSR Committee

CSR Safety and Sustainability Committee (hereinafter referred to as "CSR Committee") formed in accordance with the Companies Act, 2013 shall be responsible for guiding the planning process, oversee implementation and review programs undertaken under the policy. The CSR Committee shall recommend the annual plan and budget to the Board and shall submit periodic progress report to the Board of Directors. The Committee may also propose and recommend new programs beyond the approved annual CSR plan.

3.6.4.4 CSR Budget

Pursuant to the provisions of Companies Act, 2013 and Rules made thereunder, Nayara Energy shall spend up to 2% of its average net profits computed in a manner laid down under the provisions of the Companies Act, 2013 and made during three immediate preceding financial years. Nayara Energy shall endeavour to spend the entire CSR budget within the applicable year.

3.6.4.5 Annual Budget and Expenditure

Before the commencement of each financial year, an Annual Business Plan (ABP) for the CSR programs, both new and ongoing, along with the budget for the same shall be recommended by the CSR Committee to the Board for approval.

Surplus if any arising out of CSR projects or programmes or activities shall not form part of business profits of the Company and shall be utilized for undertaking CSR activities.

3.6.4.6 CSR Programs and Their Implementation

The CSR initiatives will be implemented either directly by the Company or through:

a. A company established under Section 8 of the Companies Act, 2013 or a registered trust or a registered society, established by the Company either singly or along with any other company

b. A company established under Section 8 of the Companies Act, 2013 or a registered trust or a registered society, established by the Central Government or State Government or any entity established under an Act of Parliament or State Legislature.

The Section 8 Company or the registered trust or the registered society may engage/collaborate with Government, Knowledge/ academic/ community institutions, private enterprises, consulting organizations, CSR program management companies, NGOs & Community based organizations.

In case the Board of Directors decides to implement the CSR activities through Section 8 company or a registered trust or a registered society other than those mentioned above, such company, trust, society shall have an established track record of three years in undertaking similar programs or projects and the company has specified the projects or programs, the modalities of utilization of funds of such projects and programs and monitoring and reporting mechanism. Nayara Energy shall build an

internal team of program managers and specialists, to monitor the implementation effectively.

Gender equality shall be an over-arching theme in each of the CSR programs. Similarly a skill based employee engagement program shall also be woven into the CSR programs. Illustrative list of programs that the Company proposes to take up is given below.

3.6.4.7 Sustainable Rural Development - *Developing Sustainable Habitats*

Programs may include common infrastructure development including roads, gaushalas, sanitation units, community halls, anganwadis, health centres and any other program, as may be required by the community.

Strategic collaboration with the communities, it can be said that the District Administration has had a major role to play. The initiatives are planned consultatively keeping in view the local, social, geographical, environmental, and the economic scenario, ensuring that people in the communities, especially the most underserved are impacted positively.

There is a major emphasis on primary, preventive and specialized healthcare, in collaboration with government health departments, healthcare organizations, NGOs and grassroots' institutions.

Similarly, a big part of what is being done involves seeking opportunities for livelihood opportunities, enhancing traditional livelihoods, and building relevant skills.

Nayara Energy Ltd. runs the CSR activities majorly in following key areas as given in **Table 3.6.8** and so far has touched the lives of about 5.8 lakh people in 4 years, during 2014-18.

A. Health and Sanitation: Different CSR initiatives have been undertaken by Nayara Energy as:

- **Community Health Project:** To provide integrated healthcare solutions in the refinery surrounding villages, the company has initiated Community Health Project in 13 surrounding villages, ensuring access to basic healthcare services. Initiatives include Community Health Centre at Jakhar, a Mother and Child care centre at Vadinar, a Mobile van, 5 Emergency Ambulances besides doing specialized health camps. More than 50,000 patients are receiving treatment annually.
- **Nutrition Support to TB patients in Devbhumi Dwarka:** The Company collaborated with the District TB Department to provide nutritional support to 301 critical patients. The aim of the program is the complete elimination of the disease from the district by 2025.
- **Study of Health Scenario at Devbhumi Dwarka:** The Company collaborated with the Indian Institute of Public Health Gandhinagar (IIPHG) to assess the gap of health care services in Devbhumi Dwarka. Recommendations by IIPHG include (i) Improving point of care diagnostic and screening by use of innovative

mobile health (m-health) technology (ii) Improve the Quality of data collection by engaging with grass root workers using mobile technology.

- **Solid Waste Management Project:** The Company implemented a comprehensive project on Solid Waste Management in 5 villages. Besides regular cleaning in the village, other activities like behaviour change communication, awareness drives were also carried out.

B. Education

- **Promoting Secondary Education through Scholarship:** Nayara Energy awarded scholarships worth INR 6 lakhs to 30 students across 15 villages. Most of the students were pursuing their education beyond VIIIth std. Care was also taken to ensure that there was a minimum of one girl from each village. The students were selected by a jury comprising of sarpanch and teachers.

  Gramshiksha (Village Education): "Gram Shiksha" is the overarching program on education in 15 villages, touching all ages between 6-35 years. Among the multiple ones catering to the mentioned age groups, scholarship dissemination to meritorious students in one. Ensuring that higher education of students is not missed out due to financial constraints, this programme has went on to become the reason why many students from low income backgrounds have been able to complete their higher education and pursue jobs. Nayara Energy awarded 75 scholarships in 6 different categories namely Post Graduation, Graduation, B.E. & Medicine, Diploma & Nursing Courses, 11th & 12th. While 338 applications (Girls 163, Boys 175) were received from 15 villages for the same, 75 students were shortlisted (Girls 39, Boys 36) on merit basis. Special focus was on girls, and further encouraging them were past scholarship winners like Ms. Parvati and Ms. Mumtaz who are the shining examples of what persistence and hard work can result in. Both of them were amongst the first ones to be awarded the same and are now employed with BAIF and Nayara Energy respectively.

- **Bharat Ek Khoj 2018:** Promoting alternate tools to ensure better learning has been the company's forte. Originally created as Bal Vividha (Creativity in Children) in 2012, the learning method transformed to Bharat Ek Khoj (Discovery of India) in 2018. Bharat Ek Khoj, is an amalgamation of facts & figures and thoughts and ideas that India is, and what children think India is… And reflecting the spirit that India, 18 schools showcased multiple social- economic-cultural facets of their assigned state.

- **Navtar – A Centre for Educational Innovation:** To strengthen the Educational Innovations and Research in primary education, the Company collaborated with Gujarat Council for Education, Research, and Training (GCERT) in the offing to develop a repository of about 10,000 educational innovations, with a view to disseminate them and promote use of innovations in day to day use in schools.

C. Initiatives in Livelihood Development

- **Veterinary Mobile Clinic:** Regular livestock health camps conducted in villages has been received overwhelmingly well. These cattle camps cater to the health issues of livestock, while also providing counselling to the keepers and owners on prevention of common diseases, their nutrition and care. Free diagnosis, medicines and treatment is also provided to the animals as a part of these camps.
- **Agriculture Development & Animal Husbandry:** With the aim to increase the income level of the farmers, the company initiated a livelihood program in 2013, focusing on Agriculture Development, Animal Husbandry, and Water Resource Development. Through this project, the efforts are being made to address issues like low land productivity, ground water depletion, lack of availability of health services for cattle, among others.
- **Stitching Centre in Vadinar**: The Company has set-up a stitching Centre in Vadinar in 2016 with the objective to provide sources of alternate income to women. The Centre is the only one of its kind in Vadinar and also serves as a platform for social interaction amongst the members.

D. Skill Development

Integrated Lab for soft-skills development (ILabss): The Company has setup a unique lab facility at ITI Khambhaliya to impart soft skill education to students who do not otherwise get this opportunity as a part of their technical education curriculum.

E. Women Empowerment

F. Infrastructure Development

- Nayara Energy is doing its bit in contributing to the Abhiyaan with construction, repair, and refurbishment of school and residential toilets across the villages. To ensure regular use and upkeep of the new facilities, Nayara Energy collaborated with NGO, Anarde Foundation to conduct customized awareness generation activities using Behavior Change Communication (BCC) tools. Various infrastructure development projects were also carried out by the company to improve the village infrastructure which include Construction of Community centres, Construction of Gaushalas and other repair and refurbishment work.

G. Environmental Sustainability

- **Water Resource Development and Management Program:** The projects aims to address the issue of water scarcity and improve the level of water quality, initiatives like bore well recharge, pond cleaning, farm bund, farm pond (repair, de-silting, and construction) and pond deepening were carried out in villages. More than 275 no. of small, medium, and large structures/ measures were created/taken to ensure water availability and quality among

others. These initiatives have additionally added total 5.27 MCM of water storage capacity in last 4 years.

- **Waste Paper recycling project:** The Company supported women's group in establishing a waste paper recycling unit at Singach, to produce high quality recycled paper. The programme caters to diverse range of capacities allowing custom designing of products as per requirements.
- **Leadership Development Program with Acumen India:** Acumen India Fellows Program is a Leadership Development program designed to connect and cultivate the next generation of social change agents with the audacity and skills to address the problems of poverty. The company has entered into a three years' agreement (2017-2019) with Acumen Fund Trust. The idea is to develop a community of emerging leaders, thereby creating a more inclusive world.

CSR initiatives undertaken in different villages by Nayara Energy in education and health sector are shown in **Figs. 3.6.6** and **3.6.7** respectively.

Glimpses of some of the programmes undertaken by Nayara Energy in different domains are shown in **Plate 3.6.2.**

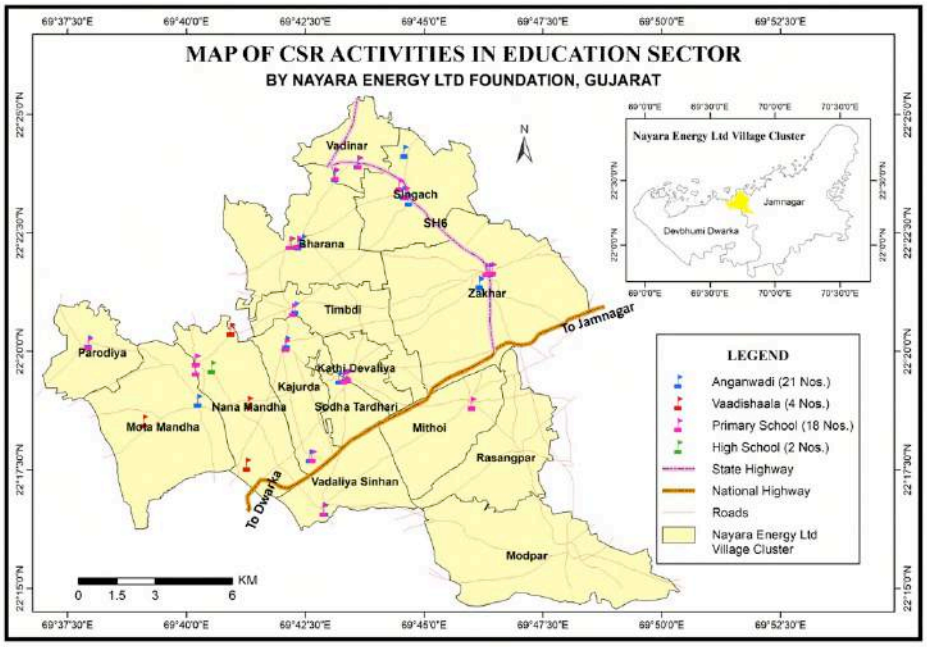


Fig. 3.6.6: Villages Covered under CSR Initiatives: Education Sector

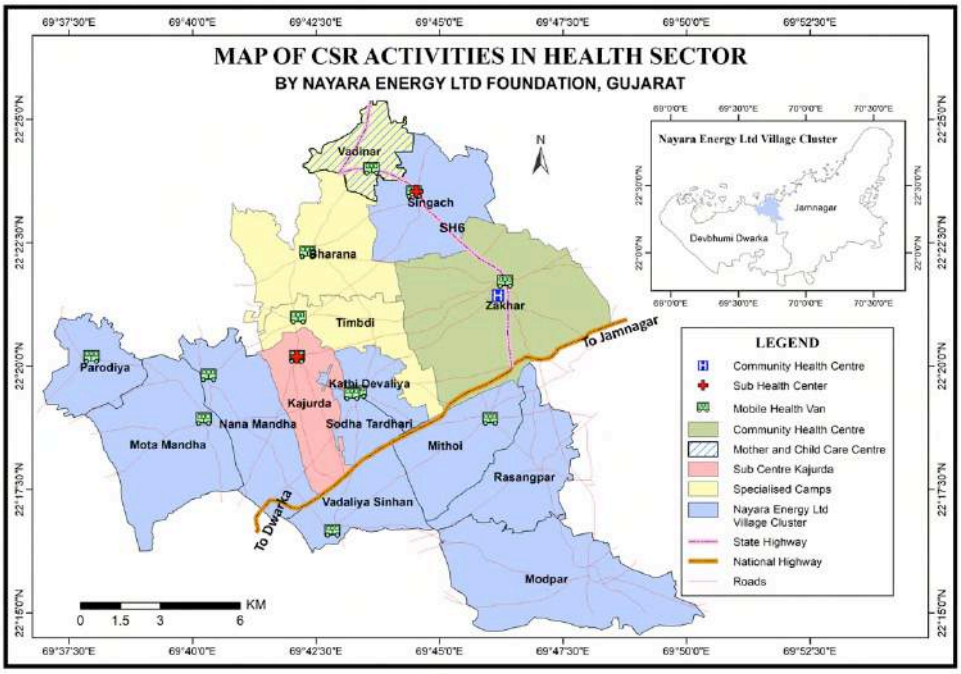


Fig. 3.6.7: Villages Covered under CSR Initiatives: Health Sector

1. Vadinar Stiching center
2. Khajurda Education Center
3. Mithoi Village
4. Khajurda Primary School
5. Vadinar Sarpanch Office

Plate 3.6.1: Photographs Showing Interaction with different Groups in the Study Area (Contd…)

6. Barana Adult Literacy center
7. Modpur Village
8. Mithoi Primary School
9. Vadinar Stiching center
10. Jhankar PHC

Plate 3.6.1: Photographs Showing Interaction with different Groups in the Study Area

Health and Sanitation

Education

Livelihood Development

Plate 3.6.2: Glimpses of Various Programmes organized by Nayara Energy under CSR Activities (Contd…)

Livelihood Development

Environmental Sustainability

Plate 3.6.2: Glimpses of Various Programmes organized by Nayara Energy under CSR Activities

Table 3.6.1: Summary of Demographic Structure in the Study Area

Demographic Parameters	Jamnagar District Tehsils			Total
	Lalpur	Khambhalia	Jamnagar	
Total No. of Villages	12	11	2	25
Total area (km^2)	162.76	105.78	21.93	290.48
Total No. of Households	4747	6065	1269	12081
Total Population	25895	30447	6829	63171
Male Population (%)	51.52	58.61	51.35	54.92
Female Population (%)	48.48	41.39	48.65	45.08
0-06 Child Population (%)	14.68	13	14.91	13.9
Density (persons per km^2)	159	288	311	217
Sex ratio (No. Females per 1000 Males)	941	706	947	821
Scheduled Castes (%)	8.99	6.07	5.59	7.21
Scheduled Tribe (%)	0.33	0.55	0.12	0.41
Literate (%)	56.46	59.26	56.86	57.85
Illiterate (%)	43.54	40.74	43.14	42.15
Total Workers (%)	39.05	42.3	30.56	39.7
Main workers (%)	35.45	36.84	29.33	35.46
Marginal workers (%)	3.6	5.46	1.23	4.24
Non workers (%)	60.95	57.7	69.44	60.3
Cultivator (%)	47.66	11.79	17.42	27
Agricultural Workers (%)	18.4	10.04	10.19	13.48
Household Workers (%)	1.19	0.34	1.55	0.79
Other Workers (%)	32.75	77.83	70.84	58.73

Source: PCA 2011, District Jamnagar, Gujarat.

Table 3.6.2: Tehsil & Village-wise Population Structure

Sr. No.	Town/ Village	Name	TRU	House hold	Total Population			Child 0-6	SC	ST
					Total	Male	Female			
Tehsil- Lalpur, District- Jamnagar, Gujarat										
1.	513868	Zankhar	Rural	726	3872	1999	1873	519	243	29
2.	513880	Mithoi	Rural	259	1395	721	674	253	276	0
3.	513881	Rasangpar	Rural	243	1208	623	585	157	174	7
4.	513878	Khatiya Beraja	Rural	97	450	230	220	79	0	0
5.	513879	Lakhiya Nana	Rural	119	656	340	316	103	65	0
6.	513882	Lakhiya Mota	Rural	226	1215	602	613	188	103	0
7.	513883	Rangpar	Rural	199	1034	525	509	143	128	0
8.	513870	Meghpar	Rural	221	1170	602	568	161	0	0
9.	513869	Jogvad	Rural	309	1706	882	824	287	282	0
10.	513867	Singach	Rural	815	4681	2392	2289	771	162	15
11.	513895	Modpar	Rural	676	3967	2112	1855	458	152	20
12.	513871	Padana	Rural	857	4541	2314	2227	683	742	14
Sub-total				**4747**	**25895**	**13342**	**12553**	**3802**	**2327**	**85**
Tehsil- Khambhalia, District- Jamnagar, Gujarat										
13.	513499	Timbdi	Rural	173	911	465	446	112	161	0
14.	513500	Kathi Devaliya	Rural	1624	6347	5310	1037	212	338	95
15.	513501	Kajurda	Rural	314	1673	876	797	276	127	0
16.	513502	Sumra Taradhari	Rural	122	664	343	321	101	0	0
17.	513494	Nana Mandha	Rural	361	1934	993	941	329	123	0
18.	513495	Nana Ambla	Rural	356	1974	1029	945	332	0	0
19.	513496	Mota Ambla	Rural	122	660	335	325	90	17	0
20.	513497	Vadinar	Rural	1706	8946	4726	4220	1358	772	72
21.	513498	Bharana	Rural	899	5287	2705	2582	832	137	0
22.	513503	Vadaliya Sinhan	Rural	325	1695	875	820	290	136	0
23.	513504	Sakhpar	Rural	63	356	188	168	27	36	0
Sub-total				**6065**	**30447**	**17845**	**12602**	**3959**	**1847**	**167**
Tehsil & District- Jamnagar, Gujarat										
24.	513599	Gagva	Rural	165	901	432	469	124	95	0
25.	513600	Moti Khavdi	Rural	1104	5928	3075	2853	894	287	8
Sub-total				**1269**	**6829**	**3507**	**3322**	**1018**	**382**	**8**
Grand-total				**12081**	**63171**	**34694**	**28477**	**8779**	**4556**	**260**

Source: Primary Census Abstract 2011, District Jamnagar, Gujarat

Table 3.6.3: Tehsil & Village-wise Literacy Status

Sr. No.	Town /Village	Name	TRU	Literate			Illiterate		
				Total	Male	Female	Total	Male	Female
Tehsil- Lalpur, District- Jamnagar, Gujarat									
1.	513868	Zankhar	Rural	2422	1359	1063	1450	640	810
2.	513880	Mithoi	Rural	649	399	250	746	322	424
3.	513881	Rasangpar	Rural	602	369	233	606	254	352
4.	513878	Khatiya Beraja	Rural	248	145	103	202	85	117
5.	513879	Lakhiya Nana	Rural	448	252	196	208	88	120
6.	513882	Lakhiya Mota	Rural	717	427	290	498	175	323
7.	513883	Rangpar	Rural	654	382	272	380	143	237
8.	513870	Meghpar	Rural	774	452	322	396	150	246
9.	513869	Jogvad	Rural	543	341	202	1163	541	622
10.	513867	Singach	Rural	2493	1456	1037	2188	936	1252
11.	513895	Modpar	Rural	2446	1510	936	1521	602	919
12.	513871	Padana	Rural	2625	1531	1094	1916	783	1133
Sub-total				**14621**	**8623**	**5998**	**11274**	**4719**	**6555**
Tehsil- Khambhalia, District- Jamnagar, Gujarat									
13.	513499	Timbdi	Rural	621	360	261	290	105	185
14.	513500	Kathi Devaliya	Rural	4941	4256	685	1406	1054	352
15.	513501	Kajurda	Rural	846	506	340	827	370	457
16.	513502	Sumra Taradhari	Rural	405	246	159	259	97	162
17.	513494	Nana Mandha	Rural	957	598	359	977	395	582
18.	513495	Nana Ambla	Rural	705	444	261	1269	585	684
19.	513496	Mota Ambla	Rural	432	257	175	228	78	150
20.	513497	Vadinar	Rural	5348	3305	2043	3598	1421	2177
21.	513498	Bharana	Rural	2680	1653	1027	2607	1052	1555
22.	513503	Vadaliya Sinhan	Rural	883	527	356	812	348	464
23.	513504	Sakhpar	Rural	224	133	91	132	55	77
Sub-total				**18042**	**12285**	**5757**	**12405**	**5560**	**6845**
Tehsil & District- Jamnagar, Gujarat									
24.	513599	Gagva	Rural	451	282	169	450	150	300
25.	513600	Moti Khavdi	Rural	3432	1992	1440	2496	1083	1413
Sub-total				**3883**	**2274**	**1609**	**2946**	**1233**	**1713**
Grand-total				**36546**	**23182**	**13364**	**26625**	**11512**	**15113**

Source: Primary Census Abstract 2011, District Jamnagar, Gujarat

Table 3.6.4: Tehsil & Village wise Employment Pattern

Sr. No.	Town/ Village	Name	TRU	Total workers	Main Workers	Marginal Workers	Non-Workers
	Tehsil- Lalpur, District- Jamnagar, Gujarat						
1.	513868	Zankhar	Rural	1065	1043	22	2807
2.	513880	Mithoi	Rural	499	489	10	896
3.	513881	Rasangpar	Rural	586	516	70	622
4.	513878	Khatiya Beraja	Rural	225	125	100	225
5.	513879	Lakhiya Nana	Rural	202	199	3	454
6.	513882	Lakhiya Mota	Rural	729	493	236	486
7.	513883	Rangpar	Rural	600	301	299	434
8.	513870	Meghpar	Rural	325	325	0	845
9.	513869	Jogvad	Rural	477	473	4	1229
10.	513867	Singach	Rural	1863	1842	21	2818
11.	513895	Modpar	Rural	1873	1783	90	2094
12.	513871	Padana	Rural	1668	1590	78	2873
	Sub-total			**10112**	**9179**	**933**	**15783**
	Tehsil- Khambhalia						
13.	513499	Timbdi	Rural	282	265	17	629
14.	513500	Kathi Devaliya	Rural	5226	4110	1116	1121
15.	513501	Kajurda	Rural	479	364	115	1194
16.	513502	Sumra Taradhari	Rural	282	264	18	382
17.	513494	Nana Mandha	Rural	607	571	36	1327
18.	513495	Nana Ambla	Rural	577	538	39	1397
19.	513496	Mota Ambla	Rural	210	210	0	450
20.	513497	Vadinar	Rural	2844	2690	154	6102
21.	513498	Bharana	Rural	1649	1485	164	3638
22.	513503	Vadaliya Sinhan	Rural	617	615	2	1078
23.	513504	Sakhpar	Rural	107	106	1	249
	Sub-total			**12880**	**11218**	**1662**	**17567**
	Tehsil & District- Jamnagar						
24.	513599	Gagva	Rural	302	288	14	599
25.	513600	Moti Khavdi	Rural	1785	1715	70	4143
	Sub-total			**2087**	**2003**	**84**	**4742**
	Grand-total			**25079**	**22400**	**2679**	**38092**

Source: Primary Census Abstract 2011, District Jamnagar, Gujarat

Table 3.6.5: Tehsil & Village wise Main Workers Employment Pattern

Sr. No.	Town/Village	Name	TRU	Main Workers Employment Pattern			
				Cultivator	Agriculture	Household	Other
Tehsil- Lalpur, District- Jamnagar, Gujarat							
1.	513868	Zankhar	Rural	266	177	18	582
2.	513880	Mithoi	Rural	162	125	1	201
3.	513881	Rasangpar	Rural	161	276	10	69
4.	513878	Khatiya Beraja	Rural	18	94	0	13
5.	513879	Lakhiya Nana	Rural	141	38	0	20
6.	513882	Lakhiya Mota	Rural	299	88	18	88
7.	513883	Rangpar	Rural	243	35	13	10
8.	513870	Meghpar	Rural	133	37	0	155
9.	513869	Jogvad	Rural	78	79	9	307
10.	513867	Singach	Rural	919	382	5	536
11.	513895	Modpar	Rural	1385	191	2	205
12.	513871	Padana	Rural	570	167	33	820
Sub-total				**4375**	**1689**	**109**	**3006**
Tehsil- Khambhalia, District- Jamnagar, Gujarat							
13.	513499	Timbdi	Rural	99	40	0	126
14.	513500	Kathi Devaliya	Rural	116	7	0	3987
15.	513501	Kajurda	Rural	145	38	3	178
16.	513502	Sumra Taradhari	Rural	60	183	1	20
17.	513494	Nana Mandha	Rural	175	196	7	193
18.	513495	Nana Ambla	Rural	171	120	2	245
19.	513496	Mota Ambla	Rural	67	40	4	99
20.	513497	Vadinar	Rural	63	41	7	2579
21.	513498	Bharana	Rural	204	50	14	1217
22.	513503	Vadaliya Sinhan	Rural	166	400	0	49
23.	513504	Sakhpar	Rural	57	11	0	38
Sub-total				**1323**	**1126**	**38**	**8731**
Tehsil & District- Jamnagar, Gujarat							
24.	513599	Gagva	Rural	85	46	4	153
25.	513600	Moti Khavdi	Rural	264	158	27	1266
Sub-total				**349**	**204**	**31**	**1419**
Grand-total				**6047**	**3019**	**178**	**13156**

Source: Primary Census Abstract 2011, District Jamnagar, Gujarat

Table 3.6.6: Details of Interaction with Different Groups in the Study Area

Sr. No.	Village Name	Key Contact Person	No. of Persons Present	Major Concerns/ Problems/ Focus Areas for CSR Activities
A.	**Lalpur Tehsil**			
1.	Zankhar	Mr. Khuman Singh	8	Education, Communication, Employment, Power, Drinking Water (Muddy), Quality & Agriculture Irrigation Problem, Health Care Facility, Health Problem (Cough & Skin), Pollution (Air, Water, Noise & Land) etc.
2.	Mithoi	Mr. Abhay Singh	10	Employment, Health (Skin), Drinking Water (Scarcity), Pollution (Air)
3.	Rasanpar	Mrs. Modiben Desukhbhai	22	Health (Skin & Cough), Sanitation, Irrigation, Drinking Water, Employment, Street-Light etc.
4.	Modpur	Mr. Lakhubhai	8	Health, Drinking Water, Education, Employment etc.
B.	**Khambhlia/Vadinar Tehsil**			
5.	Nana Mandha	Mr.Sagar Ameen	21	Load-Shedding, Employment, Health (Cough & Skin), Pollution (Air, Water, Noise & Land) etc.
6.	Vadinar	Mr. Kaleem Abdul	15	Education, Health, Transportation, Water (Color and Taste), Employment, Migration in Gulf Countries etc.
7.	Bharana	Mr. Mahaveer Singh	14	Drinking Water (Oily), Health (Dengue, Malaria & Skin), Transportation, load-shedding 2-3 hours/day etc.
8.	Khajurda	Mrs. Habeebbhai Ramabhai	15	Higher Education, Employment, Load Shedding 3-4 hours, Water, Health, Migration, Pollution (Air, Water & Land) etc.

Table 3.6.7: Estimated Quality of Life of People in the Villages Surveyed

Sr. No.	Village	Quality of Life		
		Subjective QoL(S)	Objective QoL(O)	Cumulative QoL(C)
	Lalpur Tehsil			
1.	Zankhar	0.52	0.54	0.53
2.	Mithoi	0.57	0.59	0.58
3.	Rasangpar	0.47	0.49	0.48
4.	Modpar	0.52	0.54	0.53
	Khambhlia/ Vadinar Tehsil			
5.	Nana Mandha	0.51	0.53	0.52
6.	Vadinar	0.54	0.56	0.55
7.	Bharana	0.42	0.44	0.43
8.	Kajurda	0.52	0.54	0.53
Average		**0.51**	**0.53**	**0.52**

Table 3.6.8: Peoples Benefitted under CSR Initiatives of Nayara Energy Ltd. during 2014-15 to 2017-18

Sr. No.	CSR Initiatives	No. of Persons Benefitted			
		2014-15	2015-16	2016-17	2017-18
1.	Health	57840	63181	66558	67474
2.	Education	50150	106153	20257	12719
3.	Environment	100	489	120	779
4.	Women Empowerment	0	78	590	592
5.	Livelihood	2794	5390	6565	7518
6.	Swacch Bhaarat Abhiyaan	0	11264	10398	26181
7.	Rural Development Projects	60904	463	244	
8.	Vocational Skill Development	-	-	-	640
9.	Entrepreneurship Development	-	-	-	20
Total		**171788**	**187018**	**104732**	**115923**

Chapter 4

Anticipated Environmental Impacts and Mitigation Measures

Chapter 4

Anticipated Environmental Impacts and Mitigation Measures

4.1 Impact Identification

Identification of impacts leads to quantification and evaluation of impacts and accordingly suggestion on appropriate mitigation measures. Although, in general, number of impacts have been identified while describing existing environmental status, it is necessary at this stage to identify the critical impacts that are likely to occur due to the proposed ADP-1 project of Refinery for various components of the environment.

A number of techniques are available for identification of impacts. In the present case, 'Network Method' which involves understanding of cause-condition-effect relationship between an activity and environmental parameters for identification of impacts, is found to be the most appropriate approach. Various activities and actions described earlier in preceding write-ups have been taken into consideration for generation of cause-condition-effect networks (i.e. chain of events). This method has been basically advantageous in recognizing the series of impacts that would be triggered by the proposed activities.

In this method, the first step is to list the project activities and identify the types of impacts, which would initially occur. The next step is to select each impact and identify the secondary and tertiary impacts, which are induced as a result. This process is repeated until all possible impacts are identified. The biggest advantage of this approach is that it allows for identifying the impacts by selecting and tracing out the events as they are expected to occur.

The impact identification network for selected environmental components viz. air, noise, land, socioeconomic and cultural, arising out of the proposed project activities are illustrated in **Figs. 4.1.1** to **4.1.4**. It is to be noted that in these illustrations, the lines are to be read as "has an effect on".

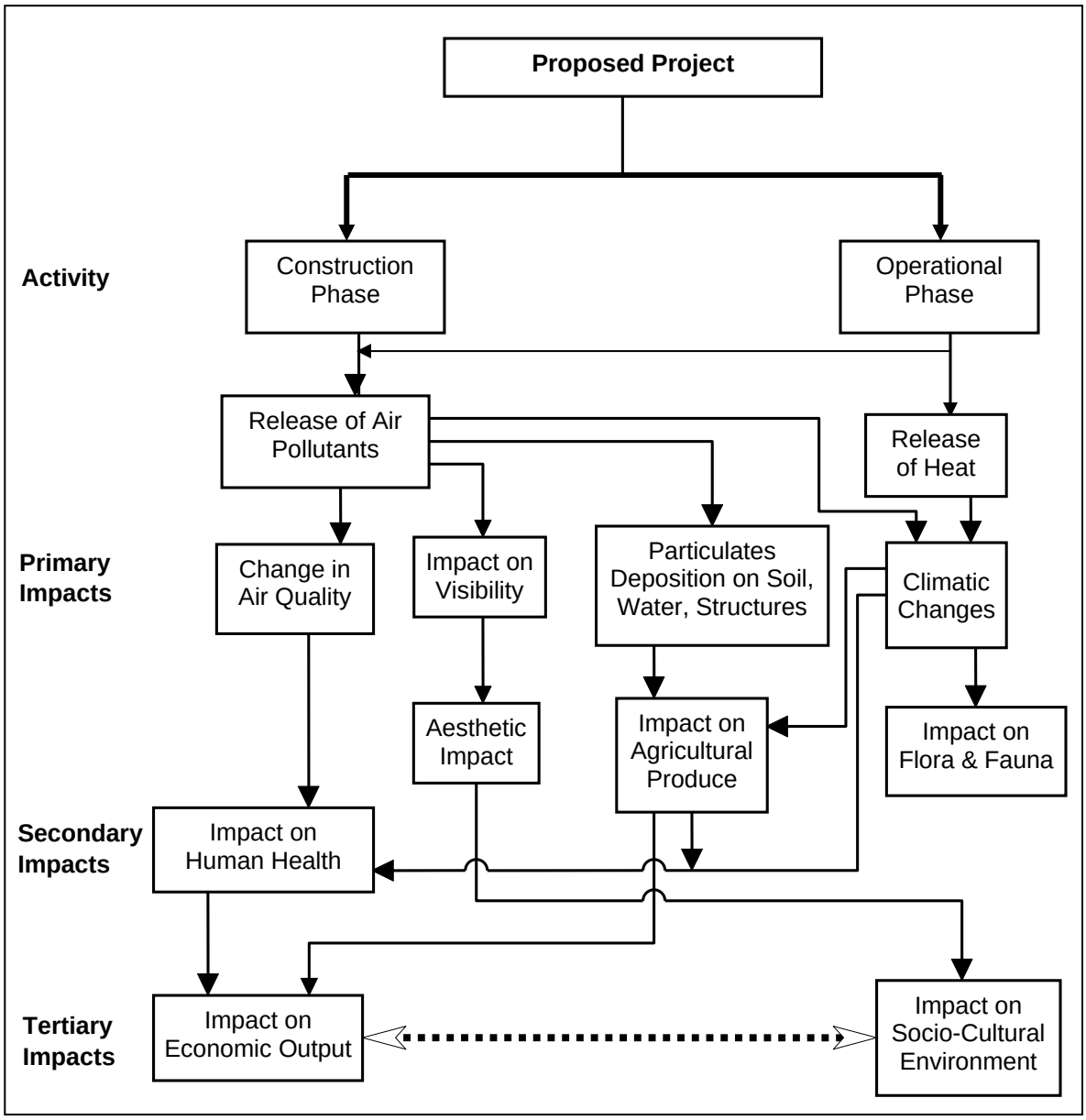


Fig. 4.1.1: Impact Network for Air Environment

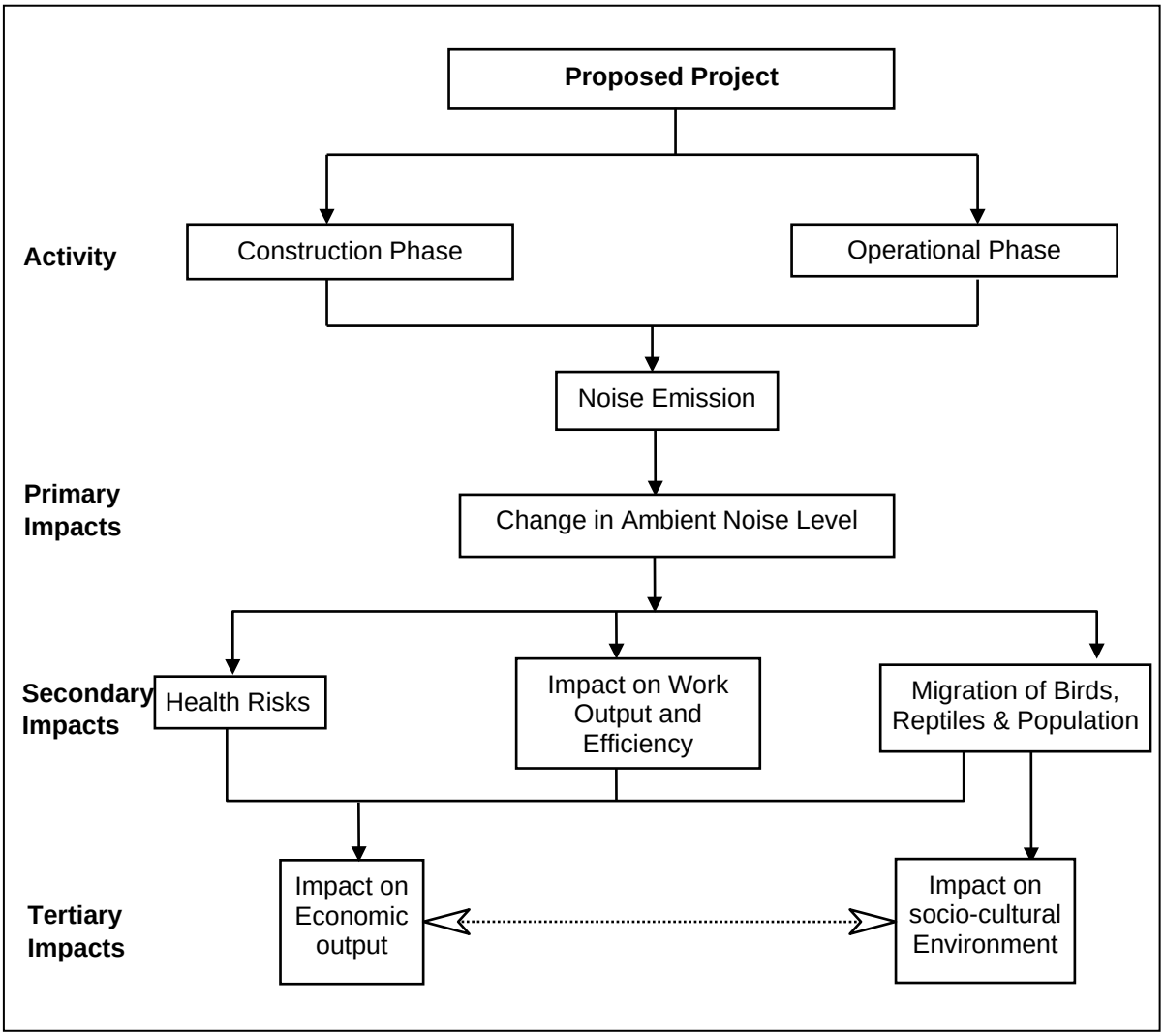


Fig. 4.1.2: Impact Network for Noise Environment

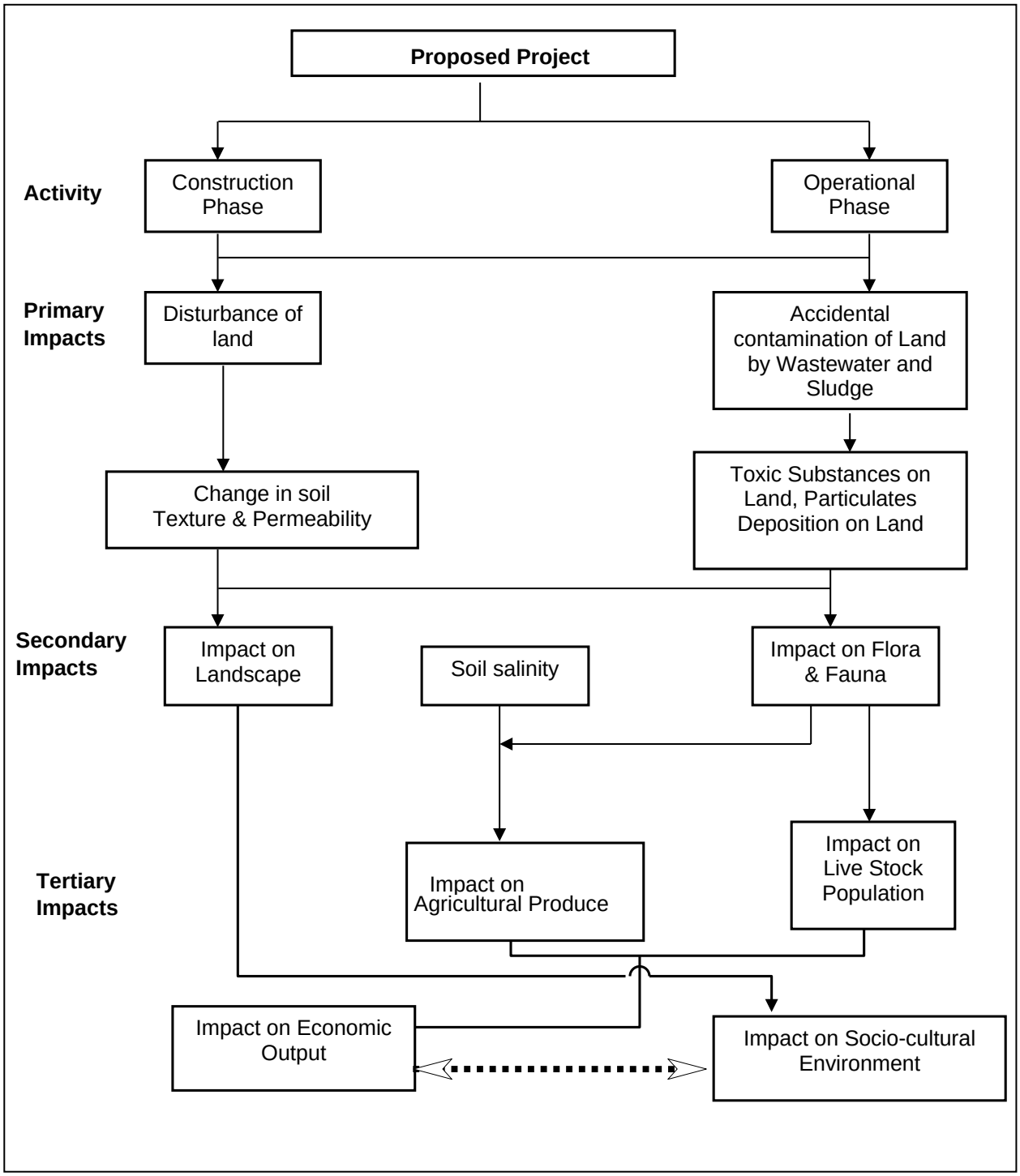


Fig. 4.1.3: Impact Network for Land Environment

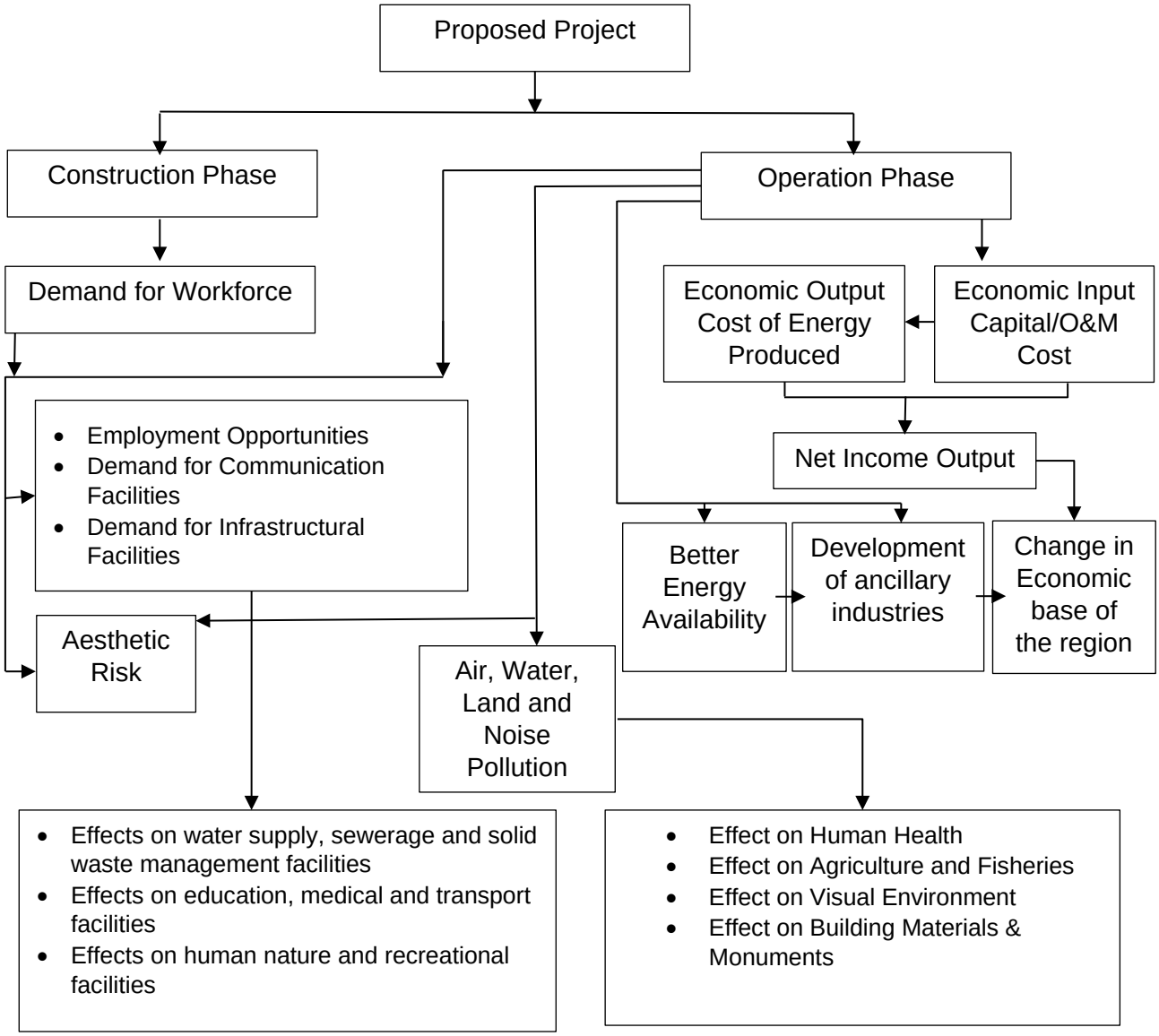


Fig.4.1.4: Impact Network for Socio-economic and Cultural Environment

4.2 Anticipated Impacts and Mitigation Measures during Construction

Topography of the proposed site is mostly flat with some undulated ground and would require cutting and grading to an extent of about 2 to 3 meters to grade the plant to the proposed finished ground level. During construction phase, the activities will be related to land de-weeding, levelling of site and construction of related structures and installation of related equipment. However, cutting or filling soil material shall be used within the plant premises, and procurement of filling material from outside is not envisaged for levelling.

Details of various equipment and machineries to be used during construction phase are given in **Table 4.2.1**.

Table 4.2.1: Details of Typical Equipment & Machinery to be used during Construction Phase

Description	Diesel Consumption (L/hr)	Quantity (Nos.)				
		During Land Grading	During Construction			
		0-6 Months	6-12 Months	12-18 Months	18-24 Months	24-30 Months
Earth Movers						
Excavator	4	2	2	1	1	-
Dozers	4	2	2	1	1	-
Trucks (10 ft-16 ft)	2	8	8	10	10	3
Dumpers	2	7	4	2	2	-
Wheel Loaders	4	2	2	1	1	-
Tractors	2	8	8	10	10	2
Scrapers, Graders	3	2	2	1	1	-
Pavers	4	1	1	1	1	-
Material Handlers						
Concrete Mixers-(Transit Mixer from Batching plant)	2	-	4	1	1	-
Cranes(Movable)	4	-	4	6	6	3
Construction Power (KW)	25 (250KVA)	250KVAx1	250KVAx3	250KVAx4	250KVAx4	250KVAx2
Maximum work hours per equipment per day	-	8	8	12	12	12
Diesel Consumption (L/day)	-	840	1384	2268	2268	864
Manpower Deployment	-	1500	2100	5000	7000	1000

4.2.1 Impact on Topography and Land Use

Topography of the proposed site is mostly flat with some undulation and drains towards north of the project area. The existing site elevation is about 35-40 m above Mean Sea Level (MSL). The proposed plant area will be suitably elevated, if required.

The cutting and filling will be balanced within the plant area. The major change in the topographical feature of area would be erection of Polypropylene Plant structures. This will be a permanent change.

Apart from the change in land use pattern within the project site there will not be any significant adverse impact on the surrounding land use during the construction period.

4.2.2 Impact on Soil

The construction activities will result in loss of vegetative cover and topsoil to some extent within the refinery premises. It is proposed to construct line drains for storm water to minimize the soil erosion. Apart from localized construction impacts at the plant site, no adverse impacts on soil in the surrounding area are anticipated.

The project site terrain is mostly flat with some undulation and therefore dozing or levelling may only be required to some extent. Vegetation on topsoil will be removed prior to commencement of bulk earth work. During dry weather conditions, dust may be generated by activities like excavation and transportation through flexible/ rigid pavements as per functional requirement of roads. The dust suspension would be arrested by using water sprinklers and by providing temporary curtain fencing.

As soon as construction work is completed, the surplus earthen material shall be utilized to fill up low-lying areas, the rubbish shall be cleared and all un-built surfaces shall be reinstated. Appropriate vegetation shall be planted and all such areas shall be landscaped. Hazardous materials (e.g. acids, paints, etc.) shall be stored in proper and designated areas as per the Hazardous Waste Management & Handling Rules, 2016.

4.2.3 Impact on Air Quality

The main sources of fugitive emissions during the construction period are the movement of equipment at site and dust emitting during the levelling, grading, earthwork and foundation works. Exhaust emissions from vehicles and equipment deployed during the construction phase are also likely to result in marginal increase in the levels of SO_2, NO_2, PM and CO. The impact will be for short duration and confined within the project boundary and is expected to be negligible outside the plant boundaries. The impact will, however, be reversible, marginal and temporary in nature. Proper maintenance of vehicles and construction equipment will help in controlling the gaseous emissions. Water sprinkling on roads and construction site will prevent fugitive dust emissions.

During construction period, there is likelihood of generation of dust and NO_x emissions. This can be attributed to levelling activity and movement of heavy duty vehicles. The transport vehicles using petrol or diesel shall be properly maintained to minimize smoke in the exhaust. Water sprinkling (may be with dust suppressants) is proposed to address dust re-suspension. Since there is likelihood of fugitive dust from the construction activity, material handling and from the truck movement in the premises of the

proposed plant, initially temporary curtains will be provided. Also the refinery shall go for tree plantation program along the boundaries of the proposed plant site.

4.2.4 Impact on Water Resources and Water Quality

De-salinated water and treated water from ETP / Narmada water will be used for construction phase activities. No groundwater is proposed to be utilized for the project during construction and operations. Hence, no impact is envisaged on the ground water resources.

The present surface and ground water resources are likely to be contaminated due to non-point discharges of solids from soil loss and sewage generated from the construction work force stationed at the site. However, as the construction will be carried out on the flat terrain, the soil losses will be negligible. Further, the construction will be more related to mechanical fabrication, assembly and erection; hence the water requirement would be meagre. Temporary sanitation facilities (septic tanks and soak pits) will be set-up for disposal of sanitary sewage generated by the work force like drivers, contract workers etc. The overall impact on water environment during construction phase due to proposed project is likely to be short term and insignificant, with adoption of precautionary measures.

During construction period, the water quality is likely to be affected due to the construction work and loosening of topsoil. This is likely to increase the suspended solids in the run-off during heavy precipitation. In order to reduce the impact on water quality, temporary sedimentation tanks shall be constructed for the settlement of the suspended matter. There is no likelihood of ground water contamination as there will not be any process effluents during construction.

4.2.5 Impact on Noise Levels

Heavy construction traffic for loading and unloading, fabrication and handling of equipment and materials are likely to cause an increase in the ambient noise levels. However, the affected areas would be close to the site. The noise generation during construction phase of the project will be temporary and will be restricted mostly to daytime, during the activity period. The equivalent levels typically measured 1 m away from major construction equipment are given in **Table 4.2.2**.

Table 4.2.2: Typical Noise Generation from Construction Equipment & Machinery

Description	Noise Levels dB(A) at 1 m from Source
Earth Movers	
1. Excavator	90-95
2. Crane	90-95
3. Trucks (10T and 16T)	84-88
4. Dozer	85-90
5. Dumpers	87-91

6. Wheel loader	89-94
7. Tractors	76-96
8. Scrapers, Graders	80-93
9. Pavers	86-88
Material Handlers	
10. Concrete mixers	75-88
11. Cranes (movable)	75-86
12. Impact Based Equipment	
13. Pneumatic Wrenches	83-88
14. Cranes (derrick)	86-88
Stationary Equipment at Storage Terminals	
15. Pumps	69-71
16. Generators	71-82
17. Compressors	74-86

Construction of the proposed ADP-1 Project may result in temporary increase in ambient noise levels in the study area on an intermittent basis. Construction noise could potentially also cause noise levels up to 70-80 dB (A) at accessible locations and can also be impulsive in nature (piling). It can be less or more, and will depend on the noise barriers that are used during the construction phase.

The noise control measures during construction phase include provision of acoustic enclosures around the equipment and regular maintenance of the equipment.

The noise impact on the surrounding population during the construction phase will be within the acceptable limits. High noise generating equipment, if used, shall not be operated during the night to eliminate any possible discomfort to the nearby residents. Community noise levels are not likely to be affected because of the vegetation and likely attenuation due to the physical barriers. The following recommendations shall be implemented:

- Provision for insulating caps and aids at the exit of noise source on the machinery;
- Use of damping materials such as thin rubber/lead sheet for shielding the work places like compressors, generator shed;
- Adoption of shock absorbing techniques to reduce impact;
- Provision of inlet and outlet mufflers which are easy to design; and
- Provision of earmuffs to the workers and enforcement of its use by the workers.

4.2.6 Impact on Terrestrial Ecology

The initial construction work at the project site involves land cleaning within the existing refinery premises. During construction activities vegetation may be disturbed which can be considered as insignificant. Greenbelt will be developed during construction phase to improve the aesthetic value and ecological condition of the area, and to screen out the fugitive dust generated during construction. The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. However, such impacts will be confined to the project site and will be minimized through paving and water sprinkling or by taking appropriate measures as the situation demands. The option of transplantation of trees (if any) will also be studied to save the existing matured trees and replant them in the area earmarked for greenbelt development.

4.2.7 Impact on Socio-Economics

The land under proposed expansion belongs to Nayara Energy Ltd., hence it does not involve any land acquisition and hence no Resettlement & Rehabilitation (R&R) issue is envisaged.

The requirement of skilled/unskilled manpower will be met preferably from nearby villages during construction phase. The project will also help in generation of indirect employment apart from direct employment. This will be a positive socio-economic development for the region.

4.2.8 Site Security

Adequate security arrangement shall be made to ensure that the local inhabitants and the stray cattle are not exposed to the potential hazards due to movement of heavy duty trucks, machinery, and handling of construction activities.

4.2.9 Migrant Workforce

Safe and secure camping area shall be provided for the migrant workforce during the construction period. Contractors shall be directed to provide adequate arrangements for water supply, sanitation and cooking fuels.

The construction site shall be provided with sufficient and suitable toilet facilities for workers to allow proper standards of hygiene. These facilities would be connected to a septic tank and maintained to ensure minimum environmental impact.

Overall, the impacts during the construction phase on the environment would basically be of transient nature and are expected to reduce gradually on completion of the construction activity.

4.3 Anticipated Impacts during Operation Phase

4.3.1 Air Environment

The impacts of air pollution from an Oil and Petroleum refinery on surrounding ambient air quality would depend upon various factors, viz. design capacity, process technology, operation & maintenance of process units and air pollution control equipment installed in the individual process units. The severity of impacts is also governed by terrain conditions around the project site and the prevailing micro-meteorological conditions in the project region.

Due to proposed project activities (ADP-1), the impacts on air quality can be envisaged due to additional stack emissions, vehicular emissions and from storage tanks. The likely emissions from ADP-1 project and their possible impact on ambient air quality is presented here.

A. Stack Emissions

The ADP-1 Project involves addition of Polypropylene Plant for production of 450 KTPA polypropylene, Propylene recovery Unit, and revamp of existing FCC Unit along with unsaturated LPG Treating Unit. Post ADP-1, the Product Slate of the Refinery will be as mentioned in Table 2.2.1 at page 10 in Chapter 2, however this will not affect the flue gas characteristics of the existing refinery and the storage tanks of different intermediate and final products, except 3 nos. of mounded bullets for propylene storage shall be added.

The proposed Polypropylene Plant will have only one additional stack/vent, which will be attached to the thermal oxidizer unit, which will be operated occasionally, when a specific grade of PP will be produced. The Thermal Oxidiser is basically an air pollution control system that is provided to control VOC emissions. ***Hence, there will be no emissions of SO_2, NO_2 or PM from the Polypropylene Plant on daily basis.***

The height of the stack/vent shall be only 30 m with diameter of 1 m, flue gas temperature of about 125°C and velocity of 11 m/s, and the impact of emissions during operation of thermal oxidizer shall be insignificant, and will not affect ambient air quality of the surrounding region.

Mechanism/process of thermal oxidizer is explained in Annexure 3 of Chapter 2.

Stack details of existing refinery are given in **Table 4.3.1.1.**

Addition of ADP-1 project shall not contribute to stack emissions, and hence there will be no impact on ambient air quality.

Table 4.3.1.1: Stack Details of Existing 20 MMTPA Refinery

Sr. No.	Stacks	Stack Height (m)	Stack Dia. (m)	Temp. (K)	Velocity (m/s)	Emissions as per MoEF&CC Norms (mg/Nm^3)*			
						PM	SO_2	NO_x	CO
1	DCU-1	65	2.5	445	6.15	10	50	350	150
2	DCU-2	65	2.5	437	5.84	10	50	350	150
3	DCU-3	65	2.5	440	8.5	10	50	350	150
4	SRU-I	82	3.9	413	7.17	-	-	350	150
5	SRU-II	82	3.9	415	7.15	-	-	350	150
6	DHDS	70	2.4	453	11.66	10	50	350	150
7	SRU	80	3.2	315	5.64	-	-	350	150
8	FCC Heater	110	3.7	441	4.99	10	50	350	150
9	FCC Regenerator	110	3.5	568	22.01	100	1700	450	400
10	CDU/VDU	130	5.7	476	9.44	100	1700	450	200
11	CDU-2	100	3.5	583	5.08	100	1700	450	200
12	NHT/CCR	130	5.7	509	10.24	10	50	350	150
13	Mini HMU	15.78	1.05	416	10.9	10	50	350	150
14	HMU-1	45	4.7	426	11.43	10	50	350	150
15	HMU-2	45	4.7	435	10.7	10	50	350	150
16	DHDT	60	2.8	449	6.93	100	1700	450	200
17	VGO MHC	60	3.1	448	8.96	100	1700	450	200

*Source: MoEF&CC, 2008

B. Vehicular Emissions

Presently, the existing refinery uses about 700 trucks on daily basis. About 10 trucks may be used for transportation of construction material during construction phase of proposed ADP-1, whereas in operation phase additional about 68 trucks may be required for transport of products. Existing main road shall be used for movement of trucks, as route is shown in **Fig. 4.3.1.1**.

Emission factors developed by ARAI, Pune have been used to determine the emissions due to additional truck movement. The details are summarized in **Table 4.3.1.2**.

Impact due to movement of traffic is predicted using the AEROMOD Line Source algorithm and 24 hourly maximum concentrations due to vehicular exhaust emissions is estimated as a function of distance from the road. The results are summarized in **Table 4.3.1.3**. Perusal of table indicates that impact of additional truck movement due to ADP-1 during construction and operation phase shall be marginal/very less for NOx and insignificant for CO and PM even at a distance of 20 m from the road.

Fig. 4.3.1.1: Truck Movement Route for Oil Transport from ADP-1 Project

Table 4.3.1.2: Pollutant Emission Inventory due to Movement of Trucks for the Refinery Activities

Scenario	Pollutant	No. of Trucks* /day	Road Corridor Length (km)	Emission Factor (g/km)**	Emission Rate (g/s)
Existing Refinery (20 MMTPA)	PM	1400	9.3	0.03	0.005
	NO_x	1400	9.3	5.8	0.874
	CO	1400	9.3	2.5	0.377
During Construction Phase of ADP-1	PM	20	7.67	0.03	0.0001
	NO_x	20	7.67	5.8	0.0103
	CO	20	7.67	2.5	0.0044
During Operation Phase of ADP-1	PM	136	9.3	0.03	0.0004
	NO_x	136	9.3	5.8	0.0849
	CO	136	9.3	2.5	0.0366

Note: *Included movement of empty trucks, ** ARAI (2018) Emission Factor of Indian Vehicles

Table 4.3.1.3: Predicted 24 Hourly Average Pollutant Concentration as a Function of Distance due to ADP-1 Project

Parameter	Pollutants Concentration (µg/m^3) at Different Distances from Road		
Distance→	20 m	50 m	100 m
Construction Phase (20 trucks – to & fro movement)			
PM	0.01	0	0
NO_x	0.3	0.1	0.05
CO	0.15	0.09	0.03
Operation Phase (136 trucks – to & fro movement)			
PM	0.07	0.04	0.01
NO_x	2.5	1.5	0.6
CO	1.0	0.5	0.2

C. Area Source (Oil Storage Tanks)

Storage tanks are used in refinery for storing and dispensing various liquids used in the refining process. These various liquids are typically organic liquids also known as petroleum liquids which are a mixture of hydrocarbons, gasoline and diesel oil. Tanks are also used for storage of intermediate distillate oil processing products. Depending upon the specific design, construction of the tank, and the characteristics of the petroleum liquids, storage tanks may emit significant amount of VOCs during typical operation, venting and tank filling or dispensing.

In the existing refinery of 20 MMTPA capacity, total number of storage tanks for various types of oil (crude oil, gasoline, intermediate oil products, final products etc.) are 141, which include 13 tanks for crude oil, 101 tanks for intermediate products and 27 tanks for dispatch of final products.

Post ADP-1, quantity of crude handling will remain same and hence no additional Crude Tank is envisaged. Only three additional mounded bullet storage tanks will be required with nominal capacity of 3621 m^3.

USEPA has suggested the common average VOC emission factors from such type oil storage tanks (USEPA, 2015). The RTI international has carried out a study on behalf of USEPA to develop Emission Estimation Protocol for Petroleum Refineries. In this report, it is suggested that common VOC emission factor from crude oil, gasoline/ other light distillates, diesel fuel/ other middle distillates, lube oil/heavy distillate oil and aromatics are 1350, 8800, 5300, 120 and 15000 pounds per million barrels, respectively. Average of these emission factors was used in the present study to estimate the VOC emission load due to evaporation from storage tanks.

It is estimated that storage tanks of existing refinery and proposed ADP-1 Project may emit approx. 57.6 tons/yr and 0.063 tons/yr of VOCs respectively. The details are given in **Table 4.3.1.4**.

Table 4.3.1.4: Details of Liquids Oil Storage Tanks with Estimated VOC Emissions

Sr. No.	Project Details	Storage Capacity (m^3)	Numbers of Tanks	VOC Emissions for Storage Tanks		
				Tons/year	Kg/day	g/s
1.	Existing Refinery	33,10,501	141	57.66	158	1.8
2.	Proposed ADP-1 Project	3621	3	0.063	0.2	0.002

Further, dispersion modeling for VOC emissions has been carried out using AERMOD model. VOC emission is a fugitive source. The existing refinery storage tanks are divided into COT area (area of 1.5 km x 0.7 km), existing refinery (area of 1.6 km x 1.2 km), and the oil storage tank for proposed Propylene plant shall be spread over an area of 0.3 km x 0.3 km approximately. The model was run for area source of average height of 15 m, which is equal to average height of storage tanks.

The predicted 24 hourly maximum GLC of VOCs emitted from the oil storage tanks is given in **Table 4.3.1.5**. The maximum GLC from existing refinery, proposed ADP-1 Project, and cumulative sources will be 8.1 µg/m^3, 0.036 µg/m^3 and 8.1 µg/m^3, respectively. These prediction levels are without any vapor recovery system.

Table 4.3.1.5: Predicted VOC Concentration under different Emission Scenarios (24 hourly Average Maximum Concentration)

Sr. No.	Scenario	Max. GLC of VOC (µg/m^3)	Distance & Direction from the Source
1.	Existing Refinery	8.1	3.5 km, South
2.	Proposed Polypropylene Pant	0.03	1 km, South
3.	Cumulative – Post ADP-1 Project	8.1	3.5 km, South of COT

In order to control emissions from different process units of ADP-1 Project, the notification (dated March 18, 2008) issued by Ministry of Environment, Forest & Climate Change shall be strictly followed. Copy of notification for refinery and petro-chemical complex is attached as **Annexure 5**.

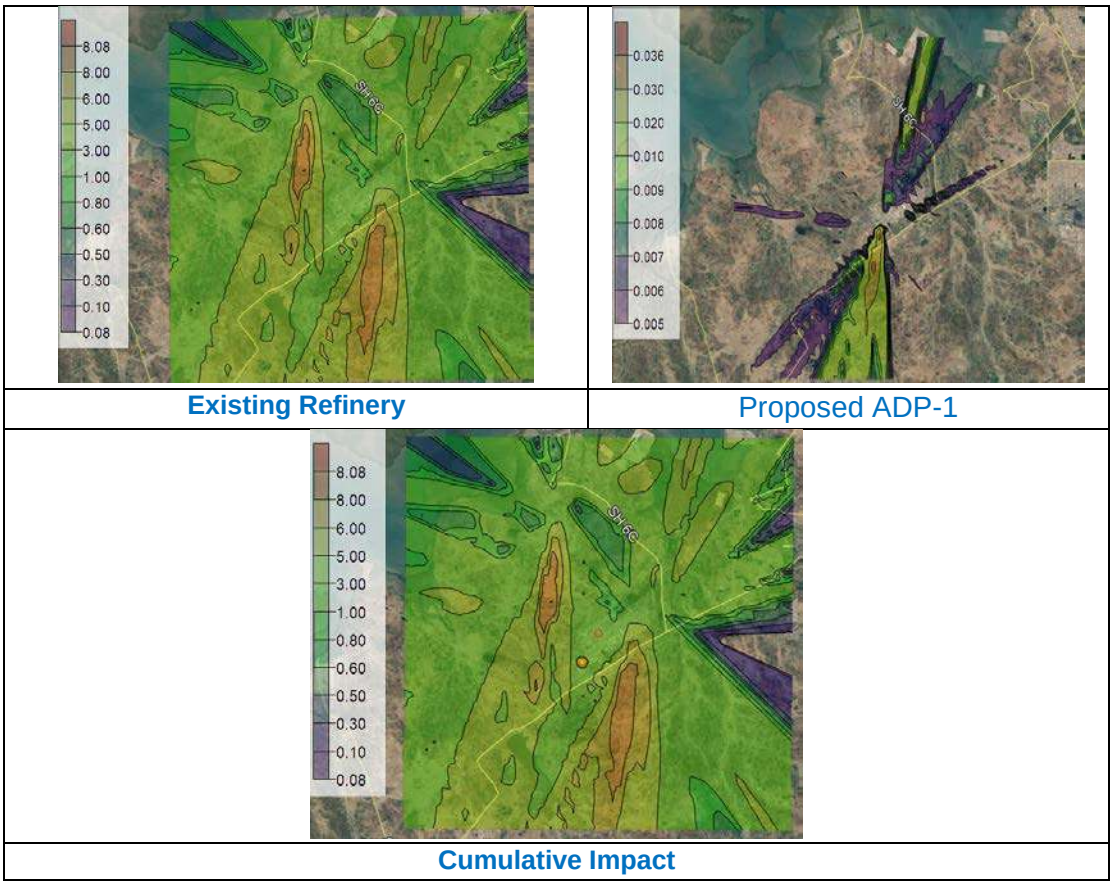


Fig. 4.3.1.2: Spatial Distribution of Predicted 24 hour Max. GLC VOC Concentration in the Study Region due to Various Storage Tanks

4.3.2 Noise Environment

4.3.2.1 Impact due to Stationary Sources

Cumulative noise level at a particular location due to noise sources can be computed by using Wave Divergence Model as given below:

$$L_{p2} = L_{p1} - 20\log\left(\frac{r_1}{r_2}\right) - Ae_{1,2}$$

Where,

L_{p2} and L_{p1} are the noise levels at the distance r_2 and r_1 respectively from the source and $Ae_{1,2}$ is the excess attenuation along the path r_2-r_1 due to environmental absorption, scattering and other shielding effects.

Total noise level, Lp (Total) due to all sources can be determined as follows:

Lp (Total) = 10 Log ($10^{Lpa/10}$ +$10^{Lpb/10}$ +$10^{Lpc/10}$)

Where,

L_{pa}, L_{pb} and L_{pc} are the noise levels at a given location due to sources A, B, C etc. Noise levels have been predicted at a distance of 100 m, 500 m and 1000 m from the proposed noise sources in process PRU and PP.

The noise sources in existing process units such as PRU and PP, mainly consist of circulation pumps, compressors and process vents etc. **Fig. 4.3.2.1** shows the predicted noise level w.r.t. distance from the sources during the operation phase.

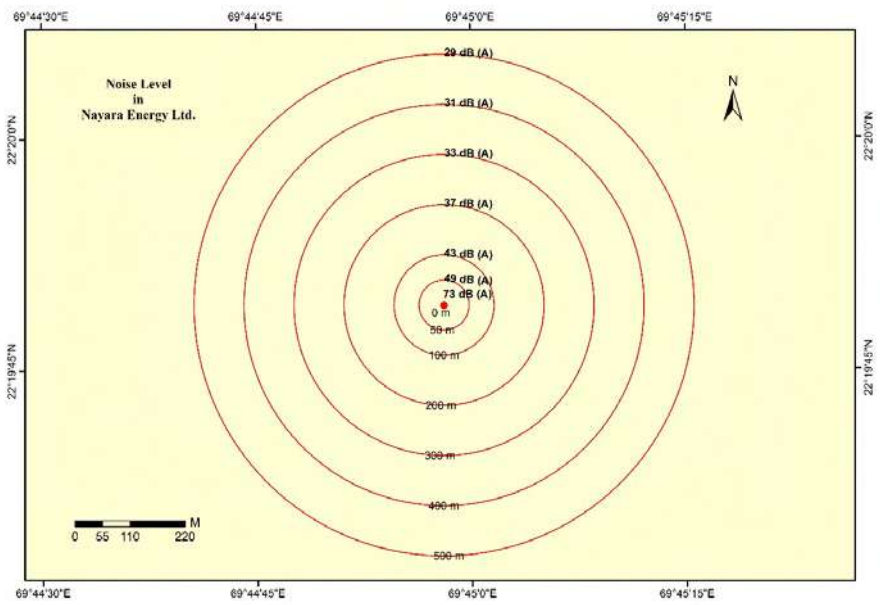


Fig 4.3.2.1: Cumulative Noise Level during Operation Phase

Noise level due to these sources is predicted to be 43 dB (A), 29 dB(A) and 23 at a distance of 100 m, 500 m, and 1 km, respectively from the sources. Noise attenuation, particularly due to air absorption and crops/grass/shrubs/plantation will be about 8 to 10 dB(A). Therefore, average noise levels from the process units would be insignificant to cause any adverse impact on the nearest habitation located at about 3 km from the site of proposed units.

4.3.2.2: Noise due to Transportation

The equivalent noise level due to traffic is estimated using FHWA (Federal Highway Administration) Traffic noise model, as:

$$Leq\ (h)i = Lo_e, + 10Log(Ni/Si*Ti) + 10Log\ (15/D)^{(1+a)} + So - 13$$

where,

$L_{eq}(h)i = L_{eq}$ at hour h for i^{th} vehicle type

Lo_e = Reference mean energy level for i^{th} vehicle type

Ni = Number of i^{th} type vehicle passing during time T

Si = Average speed for the i^{th} vehicles type in km/hr

T = Duration for which L_{eq} is desired

D = Perpendicular distance in meters from centerline of the traffic lane to the location

a = Factor relating to absorption characteristics of ground cover between the roadway and the observer

So = Shielding factorj

Noise levels for light, medium and heavy vehicles on the roads are calculated using the above model and cumulative effect is computed using the following model:

$$Leq\ (Total) = 10\ Log\ (10^{\ Leq\ L/10} + 10^{\ Leq\ M/10} + 10^{\ Leq\ H/10})$$

Where L_{eqL} , L_{eqM} and L_{eqH} are equivalent noise levels for light, medium and heavy vehicles respectively.

The area opposite to refinery main gate is affected by transportation from Dwarka to Jamnagar and back. During the study period, traffic count monitoring was carried out in front of refinery main gate at different times of the day. Traffic density observed during peak traffic hours is given in **Table 4.3.2.1**.

Table 4.3.2.1: Traffic Volumes at Highway near the Refinery Gate

Sr. No.	Monitoring time (hours)	No. of Vehicles		
		Heavy	Medium	Light
1.	Morning	200	241	1011
2.	Afternoon	112	88	467
3.	Evening	181	158	1184
4.	Night	101	57	258

The noise dispersion modeling is carried out for two scenarios having different average vehicle speed characteristics as given in the table below:

Sr. No.	Type of Vehicle	Speed of Vehicle (km/hr)	
		Scenario 1 (S1)	Scenario 2 (S2)
1.	Light	50	60
2.	Medium	45	60
3.	Heavy	40	80

Considering the above input parameters, noise levels were predicted as a function of distance from the source/road using FHWA model. The predicted noise levels for Scenario 1 and 2 are given in **Table 4.3.2.2**.

Table 4.3.2.2: Predicted Noise Level due to Vehicles Movement for Two Scenarios (S1 & S2)

Sr. No.	Distance from Road (m)	Predicted Noise Level, Leq dB(A)							
		Morning		Afternoon		Evening		Night	
		S1	S2	S1	S2	S1	S2	S1	S2
1.	5	78	82	75	79	78	82	74	79
2.	10	75	79	72	76	75	79	71	76
3.	20	72	76	69	73	72	76	69	73
4.	50	68	72	65	69	69	72	64	69
5.	100	65	69	62	66	65	69	61	66
6.	200	62	66	58	63	62	66	58	63
7.	500	58	62	55	59	58	62	54	59
8.	1000	55	59	52	56	55	59	51	56

The predicted noise levels at a distance of 5 m are further compared with the monitored Noise level during the study period. Comparison of predicted and monitored noise levels is given in **Table 4.3.2.3**.

Table 4.3.2.3: Comparison of Predicted and Monitored Noise Levels at the Refinery Main Gate due under Present Traffic Scenario

Sr. No.	Time of the Day (Hours)	Monitored (Leq), dB(A)	Predicted Noise Level (Leq), dB(A)	
			Scenario 1	Scenario 2
1.	Morning	74	78	82
2.	Afternoon	67	75	79
3.	Evening	72	78	82
4.	Night	67	74	79

Actual monitored noise levels were found less than the predicted values, which may be due to number of factors like actual vehicle speed, no. of vehicles, condition of road etc.

Additional movement of trucks due to ADP-1 project is not expected to be significantly affect the persisting noise levels in the region.

4.3.2.3 Impact of Noise on Occupational Health

Equivalent sound pressure level (Leq) averaged over 8 hours is used to describe noise exposure in work place environment. The damage risk criteria for hearing as enforced by CPCB and OSHA (Occupational Safety and Health Administration) stipulates that the noise levels upto 90 dB(A) are acceptable for 8 hour exposure per day.

The major noise sources to which workers would be exposed include turbo-generators, air compressors, feed pumps, condensate pumps, reflux pumps, recycle pumps, diluent pumps, tempering pumps, air blowers, I.D. Fans, cooling towers, booster compressor etc.

All the equipment/ machineries to be used in the proposed ADP-1 Project shall be low noise generating (<85 dB(A)) to the extent possible. Proper enclosure, packing etc. shall be made to ensure noise level generation within the limits. Further, employees working in close proximity to such units and expected to be exposed to high noise levels shall be provided and encouraged to use personal protective devices compulsory.

4.3.3 Water Environment

4.3.3.1 Water Requirement / Consumption

In an Oil and Petroleum refinery, major quantity of water is required in desalination plant feed, cooling tower, boilers etc. The total water requirement/ consumption details for the existing refinery and proposed ADP-1 Project are given in **Table 4.3.3.1.**

Table 4.3.3.1: Water Consumption Details for Existing and Proposed ADP-1 Project

Sr. No.	Purpose	Water Requirement/ Consumption (MLD)			Source
		Existing	Post ADP-1	Ultimate	
A. Sea Water					
1.	Desalination Plant Feed	154	17.3	171.3	Sea Water
2.	Cooling Towers Make up	50	-	50	Sea Water
Total		**204**	**17.3**	**221.3**	
B. Sweet Water					
3.	Domestic	4.5	0.1	4.6	Desalination Plant,
4.	Cooling Tower	17	5.9	22.9	RO/Desalination Plant
5.	Boiler	37	0.6	37.6	Desalination Plant
Total		**58.5**	**6.6**	**65.1**	

Water requirement of the Existing Refinery is met from seawater. For the proposed ADP-1 Project also, the Sea water is proposed to be used (approx. 17.3 MLD). Total projected seawater demand post ADP-1 Refinery Project works out to be 221.3 MLD.

4.3.3.2 Wastewater Generation

Wastewater generation from the process is 26 MLD for existing refinery that will become 27.1 MLD post ADP1 and will be used for Fire water/Service water, RO feed, Cooling tower makeup, Horticulture after treatment.

Seawater based cooling tower blow down is 36.5 MLD for the existing refinery, which is being returned to sea via pipeline and released through diffuser. Similarly, brine from the desalination/RO units is discharged in the sea.

Currently, 134 MLD of seawater brine including sea cooling water blowdown is discharged in the sea through 52” return header and diffuser recommended by NIO. The estimated quantity of Seawater Brine for the proposed project will be 10.9 MLD. With this, the total brine from the desalination/RO units including sea cooling water blowdown to sea, post ADP-1, works out to be 144.9 MLD.

Details of wastewater generation through different processes for the existing as well as proposed ADP-1 project are summarized in **Table 4.3.3.2**. ***The existing infrastructure for seawater return will be able to handle this additional load.***

Table 4.3.3.2: Details of Wastewater Generation through Different Processes

Sr. No.	Purpose	Wastewater Generation (MLD)			Remarks
		Existing Refinery	Post ADP-1	Total	
1.	Process	26	1.1	27.1	To be used after treatment for Fire water/ Service water/CW make up/ Horticulture etc. (includes domestic waste water)
2.	Cooling Tower blow Down (Sea Water)	36.5	-	36.5	Return to sea via pipeline and is released through diffuser as recommended by NIO
3.	Desalination/ RO Reject	97.5	10.9	108.4	

4.3.3.3 Water Balance Diagram

The seawater intake facility sources sea water which is pumped through pipeline and is utilized by desalination plant, sea water cooling tower. Water requirement for the refinery is met through seawater intake facility located in the Pathfinder creek. The facility consists of a seawater intake well to the south of the Deendayal Port Trust (DPT) jetty; pump house and a 44 inch GRP pipeline from the Pump House to the Refinery complex. Chlorine-dosing package is installed at the pump house to prevent marine growth in the intake system. This seawater after filtering is utilized for cooling as well as to produce freshwater through desalination. The return water is discharged through 52 inch pipeline and diffuser as approved by NIO.

Existing Sea water supply & return infrastructure is sufficient to handle the additional water requirement due to ADP-1 Project.

As detailed in preceding sections, water balance diagram for the existing 20 MMTPA Refinery and post ADP-1 project scenario is shown in **Figs. 4.3.3.1 & 4.3.3.2**, respectively.

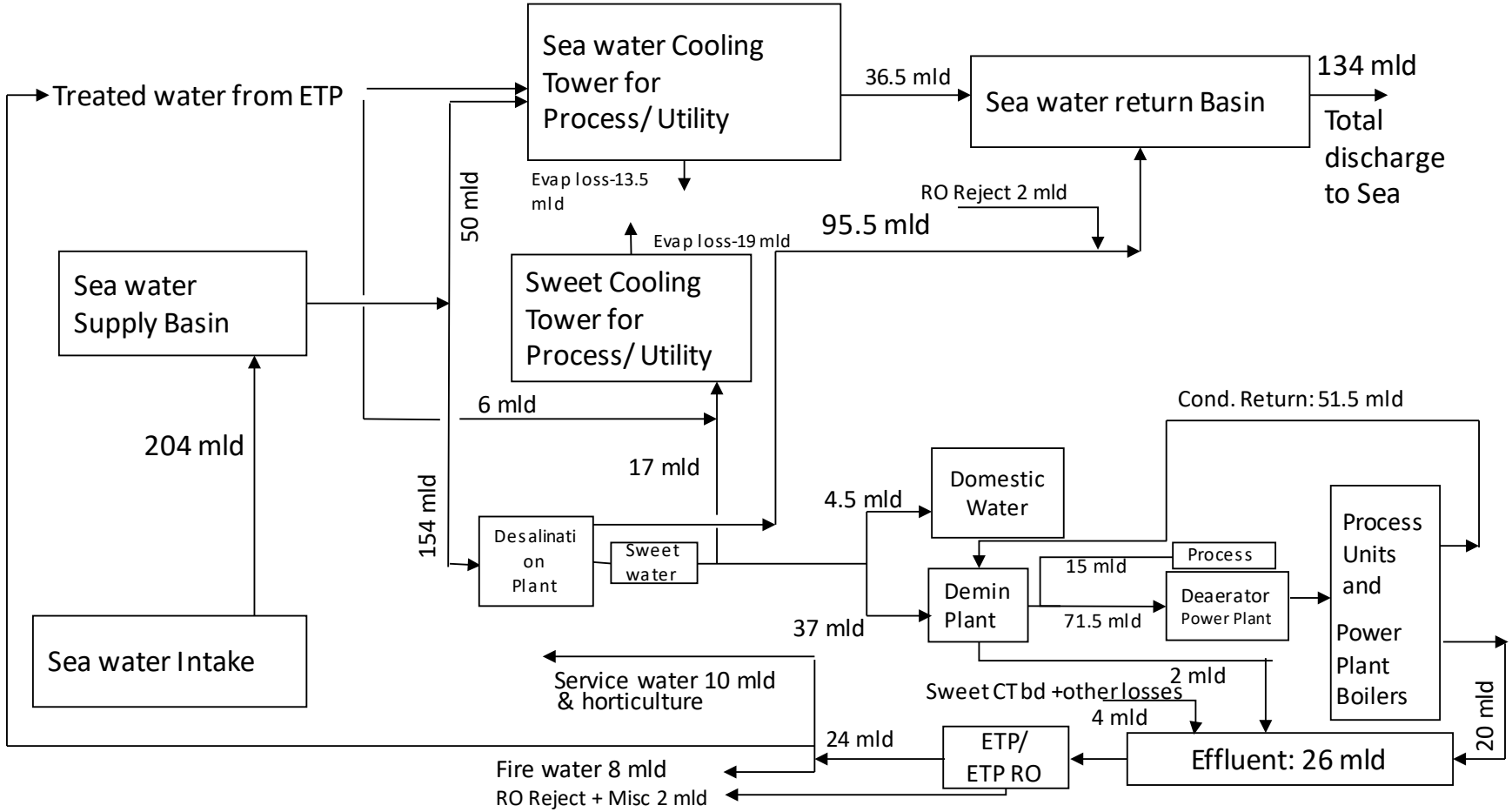


Fig. 4.3.3.1: Water Balance Diagram for Existing 20 MMTPA Refinery

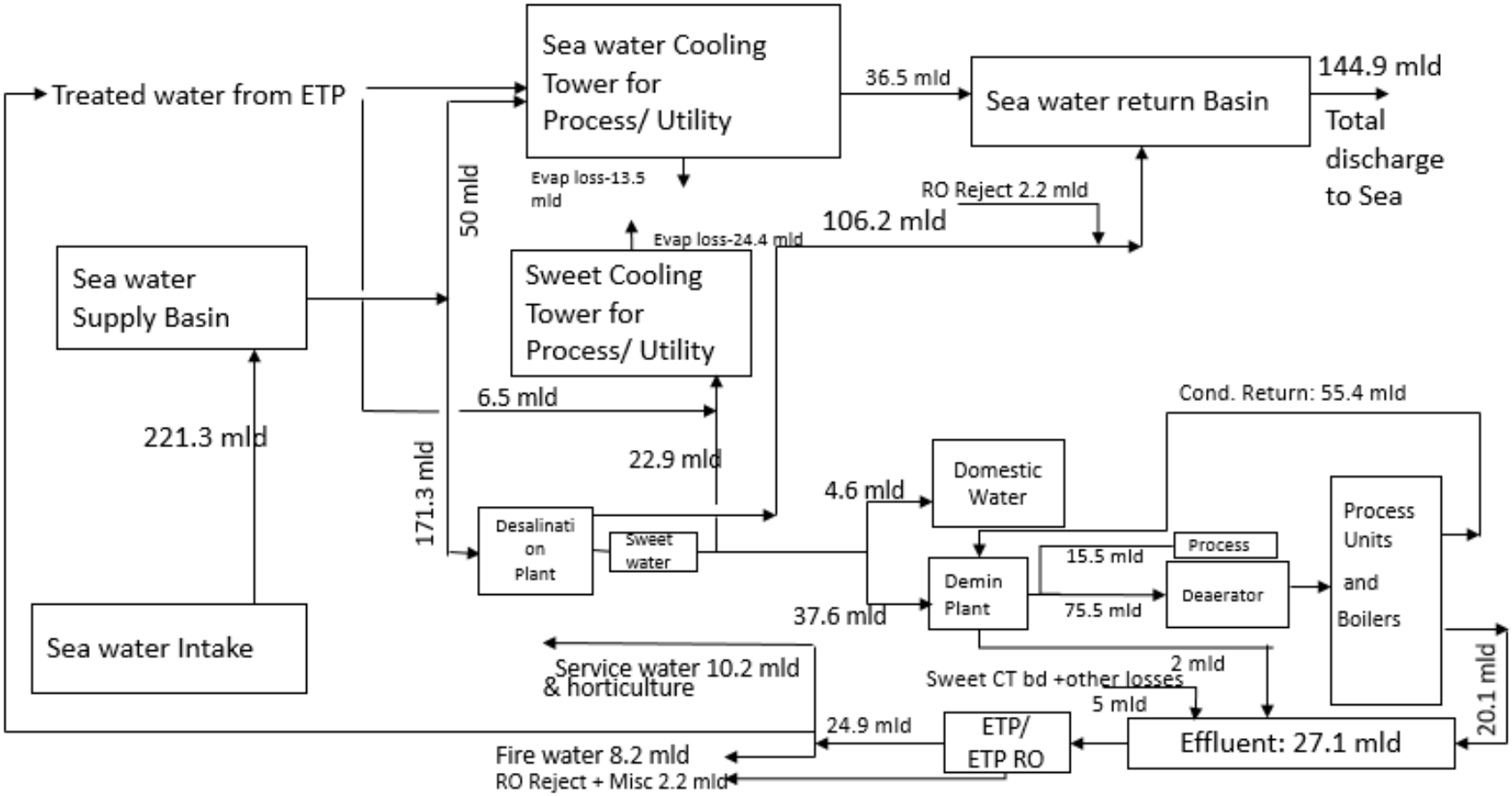


Fig. 4.3.3.2: Water Balance Diagram for Ultimate 20 MMTPA Refinery with ADP-1 Project

4.3.3.4 Wastewater/Effluent Treatment Facilities for Existing Refinery

The existing wastewater treatment facility (WWTF) is designed to handle all types of high TDS and low TDS (including rainfall) effluents from the refinery process, tankage, loading and utility, PIT and COT areas. The WWTF also handles sanitary wastewater from the refinery buildings and other administrative area.

The treated sweet water is used as fire water, service water, green belt etc., and salt water is used as RO feed. Capacity of base refinery ETP is 26 MLD. Wastewater treatment facility consists of two streams, sweet water treatment and salt-water treatment.

The function of wastewater treatment facilities is to handle Continuous oil contaminated wastewater (COC) and accidentally oil contaminated wastewater (AOC), Desalter water, stripped water and cooling tower blow down.

For the base WWTF, AOC and COC water is sent to Primary Treatment unit (PTU) for removal of free oil and dirt by gravity separation through Tilted Plate Interceptor and oil skimmer. In refinery five PTU are provided at different locations for Process, PIT, RLCB, TLCB and COT area. All the primary treated water is collected & equalized in the oil separation basin.

The wastewater treatment scheme can broadly be classified into the following sections as:

Section 1: Pre Treatment for removal of free oil (primary oil removal system)

Section 2: Free Oil removal and physico-chemical treatment for removal of sulphides and emulsified oil (secondary oil removal system)

Section 3: Biological treatment

Section 4: Tertiary / Polishing treatment

Schematic diagram of wastewater treatment facility for the existing refinery is shown in **Fig. 4.3.3.3**, and treatment processes are discussed in detail.

Section 1: Primary Oil Removal System (Pre-Treatment for Removal of Free Oil)

The first step of the treatment is for removal of free oil and sludge by gravity separation in the Pre Treatment Plants (PTP) located at WWTF area itself. The individual PTP's have been provided for each stream of Sweet WW & Salt WW.

Collection Sump: It receives effluents from ISBL and OSBL units, which is collected in Sweet and Salt WW collection sump. Both effluent collection sumps are equipped with belt type oil skimmers to remove/skim free-floating oil on effluent. Skimmed oil will be transferred by gravity to common recovered oil pit.

API Separators: Effluent collected in respective collection sumps is pumped by API feed pumps to API separator. API separator removes oil globules of size >150 micron and suspended solids by gravity separation. Recovered slop oil will be skimmed

off by skimmer and routed by gravity to common recovered oil pit. Settled suspended solid sludge is drained periodically to common oily sludge collection sump.

Tilted Plate Interceptors: Treated effluent from API mechanism is routed by gravity through Tilted Plate Interceptor (TPI) inlet channels to TPI mechanism. Slotted pipe skimmer is provided at the top of the oil separator for removing the free oil layer from the top of the tank. The tilted plates, inclined at an angle of 45º are mainly to remove the sludge accumulated at the bottom of the unit. The oily sludge collected is routed to the common oily sludge sump. Treated TPI effluent is routed by gravity to secondary oil removal system.

Section 2 - Secondary Oil Removal System (Free Oil removal and physico-chemical treatment for removal of sulphides and emulsified oil)

Overflow from TPI separator is routed through TPI outlet chamber to secondary oil removal system, which consists of a pH adjustment tank, flash mixing tank, flocculation tank and DAF unit.

pH Adjustment Tanks: Effluent is received in pH adjustment tank of each stream. Sweet WWS pH adjustment tank & Salt WWS pH adjustment tank are equipped with agitators for proper mixing of pH adjustment chemicals. Residence time of 10 min is provided in each pH adjustment tank. Provision is made in each pH adjustment tank to dose Sulphuric acid and 20% caustic to adjust the pH of effluent in range of 7 to 7.8.

Flash Mixers: pH adjusted effluent is routed to flash mixer tank for Sweet WWS & for Salt WWS where ferric chloride dosing provision is provided for coagulation of colloidal and suspended solids. Residence time of 1 min is provided in each flash mixer. Sulphides are removed by adding Hydrogen peroxide.

Flocculation Tank: Post flash mixer effluent is further treated in flocculation tank for Sweet WWS & for Salt WWS. Residence time of 20 min is provided in each flocculation tank. De-oiling Polyelectrolyte (DOPE) is dosed in the Flocculator to break the oil-in-water emulsion.

Dissolved Floatation Air (DAF) Section: DAF system consists of FRP plate pack DAF mechanism and saturation vessel. In the DAF system (Sweet & Salt WWS DAF mechanism), part of the treated effluent is recycled back through DAF recycle pumps after saturating it with air provided by plant air header, under pressure in the saturation vessel (Sweet & Salt WWS saturation vessel). The oily froth generated in the floatation tank is collected through oil skimmer. The froth skimmed at the top contains the separated demulsified oil along with suspended solids. Part of the sludge also settles at the bottom of the tank, which is removed periodically. Floatation oil and oily sludge are collected in Sweet & Salt DAF sludge sump and is routed to common oily sludge sump by DAF oil/sludge pumps.

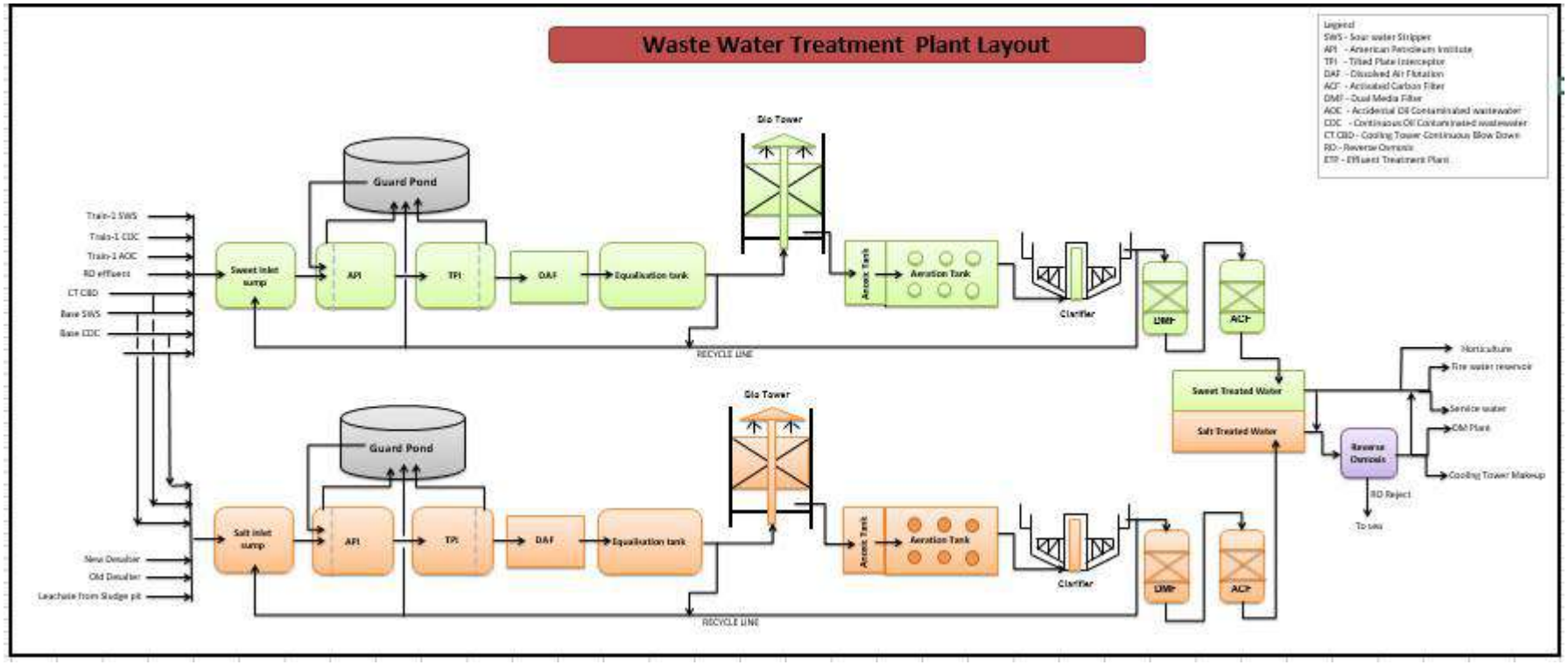


Fig. 4.3.3.3: ***Schematic Process Diagram for Waste Water Treatment Plant for Existing Refinery***

Equalization Tank: The treated effluent from the DAF unit is routed by gravity to the Sweet & Salt Equalization Tank for equalization of flow and characteristic variations in the stream, in order to achieve better operational control in the down-stream units. Each equalization tank is designed for 12 hrs residence time. Air grid is provided at the bottom of each tank to achieve better equalization of effluent. Dedicated air blowers are provided to each tank. Equalization tank is equipped with oil skimmer, equalization tank air blowers and equalization tank discharge pumps.

Guard Pond: High swings in flow due to peak flow from various units, the effluent water is diverted downstream of API separator into Guard tanks to manually limit and slowly bring backwater for treatment. The Guard pond is designed for 12 hours storage at design flow to the unit. These tanks have oil-skimming facilities and conical bottoms for easy draw off settled sludge. This tank will also act as off quality effluent collection tank. The off quality effluent before DAF, whose parameters are not in line with the desired parameters is diverted to guard pond and is treated again in flow control manner.

Section 3: Biological Treatment

A two stage biological treatment is provided for biodegradation of organic matters for reduction of biochemical oxygen demand (BOD)/ chemical oxygen demand (COD). It comprises of Bio Tower (plastic media) followed by nitrification/de-nitrification Extended Aeration Activated Sludge system with an Anoxic Tank.

Bio Tower: The overflow from Equalization tank enters the Bio Tower Feed Sump to the Bio Tower for reduction of soluble organics and Phenol.

Anoxic Tank (Sweet WWS Anoxic tank & Salt WWS Anoxic tank)- In this process, an Anoxic Tank has been added upstream of the Aeration Tank along with mixed liquor recirculation from the aerobic zone to the tank to achieve higher levels of de-nitrification. In the aerobic zone, autotrophic bacteria convert ammonia-nitrogen to nitrite-nitrogen and then to nitrate-nitrogen. In the anoxic zone, heterotrophic bacteria convert nitrate-nitrogen to nitrogen gas, which is released to the atmosphere.

Aeration Tank: The aeration tank is equipped with fixed type diffuse aerators, which provide both aeration and mixing in the tank. Aerobic conditions are maintained in the tank by entrainment of the air via the diffused aeration. Continuous air blowing is maintained by aeration tank air blower. Nutrients like Urea solution and TSP solution are dosed at the inlet of aeration tank to provide nitrogen and phosphorus to the microorganisms and maintain C, N, P ratio. Sanitary waste is added in the inlet of the Aeration tank for its biological treatment along with the effluent from Bio tower. The overflow from Aeration tank enters the Final Clarifier for solid liquid separation.

Secondary Clarifier: The Clarifier is provided with a sludge scraper, which revolves slowly to scrape the bio solids settled at the bottom. The collected sludge is recycled back via bio sludge recirculation pumps to the aeration tank to maintain required range of mixed liquor volatile suspended solids (MLVSS).

Section 4: Tertiary / Polishing treatment

The treated effluent is then polished for partial removal of suspended particles in a sand filter and residual refractory organic materials, if any, in activated carbon absorbers. The effluent from the outlet of clarifier enters the Dual Media Filter (DMF) followed by Activated Carbon Filter (ACF). Treated Sweet WW is pumped, based on requirement, as a feed to RO plant, Refinery service water network, Refinery Horticulture network, fire water make up.

Average characteristics of final treated wastewater/effluent along with GPCB limits are given in **Table 4.3.3.3.**

Table 4.3.3.3: Average Characteristics of Treated Effluent with GPCB Limits

Sr. No.	Analysis	Annual Average	GPCB Limit
1.	pH	7.48	6.5- 8.5
2.	TSS	14.3	20
3.	Oil & Grease	<4	5
4.	Phenolic Compounds	<0.1	0.35
5.	Sulphide	0.37	0.5
6.	BOD	10	15
7.	COD	34	125
8.	Cyanide	<0.05	0.2
9.	Ammonical Nitrogen	<5	15
10.	TKN	<5	40
11.	Phosphorus	0.35	3
12.	Hexavalent Chromium	<0.1	0.1
13.	Total Chromium as Cr	<0.001	2
14.	Lead as Pb	<0.003	0.1
15.	Mercury as Hg	<0.002	0.01
16.	Zinc as Zn	0.03	0.5
17.	Nickel as Ni	0.12	1
18.	Copper as Cu	0.07	1
19.	Vanadium as V	<0.01	0.2
20.	Benzene, (µg/l)	<0.001	0.1
21.	Benzo(a)pyrene, (µg/l)	<0.001	0.2
22.	Flow rate, (m^3/hr)	752	1058

All parameters are in mg/l except pH, Benzene, Benzo(α)pyrene and flow rate.

4.3.3.5 Wastewater/Effluent Treatment Facilities for Proposed ADP-1 Project

Existing refinery has Effluent treatment plant with 30 MLD design capacity. Currently, the wastewater generation is approximately 26 MLD. Proposed ADP-1 Project is expected to generate about 1.1 MLD effluent from various streams which will be sent to the existing WWTP. This will make the total wastewater load to 27.1 MLD. The existing WWTP is sufficient to handle this additional load. The treated water shall be reused for service water, Fire water make up, CW make up and horticulture.

4.3.4 Land Environment

Adequate land is available at the project site of existing refinery and there is no further land requirement for the proposed ADP-1 project. Total land available is 2275 ha (plant area including open spaces like roads and safe distances and future expansion), whereas the requirement for ADP-1 is only 40 ha. Breakup of land utilization for facilities in existing refinery and with ADP-1 Project is given in **Table 4.3.4.1**.

Table 4.3.4.1: Details of Land Availability

Sr. No.	Land Use	Existing Refinery (ha)	Total Utilized land Post ADP-1 (ha)
1.	Plant Area (including open spaces like Roads and safe distances)	761	801
2.	Green Belt	410	410
Total		**1171**	**1211**

Greenbelt area shall be 33% of total area of existing as well as proposed ADP-1 project.

A. Solid and Hazardous Waste Management from Existing Refinery

Refinery believes in Effective Waste Management because Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. Towards the mission of Effective Management of Wastes generated Refinery has implemented Standard Operating Procedure for management of wastes.

Details of different types and quantity of solid and hazardous wastes generated in the existing refinery, their storage and disposal practices followed during 2017-18 is summarized in **Table 4.3.4.2**.

Table 4.3.4.2: Details of Types of Waste Generation, Disposal, and Storage Methods (2017-18)

Sr. No.	Description of Wastes	Gene-ration (MT)	Disposal (MT)	Generation & Storage of Wastes	Disposal of Wastes
1.	Oily Sludge from ETP	3584	4255	Oily sludge is stored in Reinforced Cement concrete (RCC) pits lined with 1.5 mm thick HDPE liner & connected to leachate collection sump which is finally connected to ETP where leachate is treated.	Collection, Storage, Transportation and disposal through TSDF/ Incineration /actual users/ co-processing in DCU
2.	Oily Sludge or Emulsion	400	12.5	The waste is packed in MS drums of 200 Kg and storage facility having	Collection, Storage, Transportation and disposal through

				HDPE liner, Reinforced Cement concrete (RCC) floor, covered at the top & Leachate collection and treatment facility.	TSDF/ Incineration /actual users/ co-processing in DCU
3.	Used lubricating oil	51	26.06	The waste is packed in closed 200 Kg. MS drums and storage facility having HDPE liner, Reinforced Cement concrete (RCC) floor, covered at the top & Leachate collection and treatment facility.	Collection, Storage, Transportation & Disposal through selling it to re-refiner units
4.	Wastes / residues containing oil	20.5	12.6	Stored in the storage facility having HDPE liner, Reinforced Cement concrete (RCC) floor, covered at the top &	Collection, Storage, Transportation and disposal through TSDF/ Incineration / actual users
5.	Spent Catalyst from Various units	180.23	541.40	Packed in 200 lit MS Drums, closed from top with lid & ring and then stored in the storage facility having Reinforced Cement concrete (RCC) floor and covered at the top.	Collection, Storage, Transportation & Disposal through actual users/ TSDF/ Incineration
6.	Spent Resins waste	12.58	12.58	Generated from Water treatment process. Packed in 200 lit MS Drums, closed from top with lid & ring and then stored in the storage facility having Reinforced Cement concrete (RCC) floor and covered at the top	Collection, Storage, Transportation and disposal through TSDF/ Incineration / actual users
7.	Slop Oil	27272	27272	Slop oil generated is collected in slop oil Tanks having combined capacity of 6500 $m^{3.}$	Reused within the plant
8.	Discarded Empty Drums/ Containers	14295 Nos	11380 Nos	Stored in the storage facility having Reinforced Cement concrete (RCC) floor and covered at the top.	Collection, Storage, Transportation & Disposal through actual users
9.	Expired Hazardous Chemicals	0	0	The waste is packed in closed drums and stored in the Hazardous waste storage facility having HDPE liner, Reinforced Cement concrete (RCC) floor, covered at the top & Leachate collection and treatment facility.	Collection, Storage and disposal through TSDF/ Incineration / Selling to Pollution Control Board authorized Re-users/ Re-processors
10.	Insulated Copper Wire	0.860	15.45	Stored in Open RCC Floor at warehouse and yard	Collection, Storage, Transportation and

	Scrap/ Copper with PVC Sheathing Cables				disposal by selling it to registered recycler / actual users
11.	Contaminated Cotton rags or other cleaning materials	6.32	0	Packed in Drums and then stored in the storage facility having Reinforced Cement concrete (RCC) floor and covered at the top	Collection, Storage, Transportation and disposal through TSDF/ Incineration / actual users
12.	e- Wastes	11.4	8.7	Stored in the storage facility having Reinforced Cement concrete (RCC) floor and covered at the top.	Collection, Storage, Transportation and disposal by selling it to registered recycler / actual users
13.	Lead Acid Batteries Waste	10.15	17.68	Stored in Reinforced Cement concrete (RCC) pits lined with 1.5 mm thick HDPE liner & connected to leachate collection sump which is finally connected to ETP where leachate is treated.	Collection, Storage, Transportation and disposal by selling it to registered recycler / actual users
14.	Waste Coke/ Heater Deposits	14.57	14.57	Stored in 1 MT jumbo bags at storage facility having Reinforced Cement concrete (RCC) floor and covered at the top.	Collection, Storage, Transportation & Disposal through actual users/ Incineration / TSDF
15.	Spent Carbon	141.63	138.53	Packed in closed MS drums of 200 Kg stored in the storage facility having Reinforced Cement concrete (RCC) floor and covered at the top.	Collection, Storage, Transportation and disposal through TSDF/ Incineration / actual users/ Incineration in power plant boilers

Hazardous Waste Management

Refinery has dedicated 3 nos. of Hazardous waste pits with 3000 m^3 capacity each and two Hazardous waste storage sheds with 11600 m^2 area with HDPE linear facility for storage of all types of hazardous wastes, e- wastes and batteries wastes. The existing hazardous waste management facilities are shown in **Plate 4.3.4.1**.

Plate 4.3.4.1: Hazardous Waste Management Facilities at Nayara Energy Ltd.

B. Hazardous waste Generation due to ADP-1 Project

Major Hazardous waste generation from the ADP-1 Project shall be as below:

Unit	Solid Waste	Quantity	Frequency
PRU	Catalyst/ adsorbents	75 Tonne	Once in 4 years
PP	Catalyst/ adsorbents	194 Tonne	Once in 4 years

Existing hazardous waste management facilities are sufficient to handle the additional waste from ADP-1. Further, Hazardous Waste Management Rules, 2016, stipulated by MoEF&CC shall be followed, along with any rules/ guidelines prepared by the State Govt. in this regard.

4.3.5 Biological Environment

The identified site for proposed ADP-1 project is within the existing premises of the Refinery. The proposed project is not envisaged to have any significant impact on the nearby forest area and human habilitation and livelihood as these are not in close vicinity of proposed project site. However, during site visit the possible impacts on terrestrial flora and fauna are summarized here.

There are no notified ecological sensitive area such as National Park, Wildlife sanctuary, dense forest within the study area except Reserve Forest near Meghapar and Sinhan Dam. Both these reserve forests fully comprise of Prosopis juliflora (Vilayati Babul) plant and other bushy scrub-plants, which indicates that there is no threat to the biodiversity due to proposed project activities.

The ADP-1 activity does not involve extensive clearing or modification of vegetation as there is no major plant species exist at the proposed site. Bushy growth will be removed. Most of the land in the study area is void of vegetation.

At present the flora and fauna at the project site and in surrounding area do not consist of any major rare or endangered species except Indian Peafowl i.e. Schedule I species protected under Wildlife Protection Act (1972). Though, this species has been observed to dwell in natural surroundings of developed green belt of refinery and also in village areas and forest patches. Hence, proposed activities are not going to have any significant and irreversible impact on the presence of Peafowl in the study area.

Proposed project does not envisage any destruction or displacement of existing native fauna species hence, direct adverse impact on any faunal or floral species or on its habitat is ruled out. The proposed project activities inside existing premises of refinery are to be designed with all necessary pollution prevention/ control measures. As per the prediction results related to air quality, noise and coastal marine water quality; impacts would be well within the prescribed regulatory standards, hence the impact would be insignificant if regular monitoring and standards are followed.

The Refinery carried out extensive work on greenbelt development within the complex area. The existing greenbelt has been wisely designed and provides habitat, food and breeding shelter to variety of birds, small animals and insects. It also helps in conservation of many resident and migratory birds. Proposed activities are not going to have any direct, long term or irreversible impact on existing avifaunal and mammalian or insect species during construction or operational phase.

The impacts on terrestrial as well as coastal marine ecology from proposed project would be insignificant in the surrounding study area.

In view of the current baseline data generated during field survey, review of working plan of Jamnagar Forest Division and available published secondary data, the impacts on terrestrial ecology, flora and fauna from proposed expansion activities would be negligible/minimal in the surrounding study area if suggested EMP is taken into consideration for effective implementation, rather it would improve the ecology of the region.

4.3.6 Socio-economic Environment

Expansion of the refinery within the area would create beneficial as well as adverse impacts on the socio-economic environment. These are briefly described here as positive and negative impacts.

Positive impacts

- Increase in job opportunities for local as well as people in the region during construction and operation phase of the project
- Increase in business opportunities for the local people, due to which economic status of the people would increase
- Increase in infrastructural resources, by way of transport and communication, which may further improve the quality of life of the people in that area
- Due to the modernization of refinery there would be an overall development of the area and additional job opportunities would be created which will improve the quality of life of the people in that area
- Improve polypropylene products to meet the increasing demand of various consumers in the state, and the country
- As such, the positive impacts would consequently lead to an upliftment in the Quality of Life of the people in the area.

Negative Impacts

- Influx of workers during project construction and operation phase would put strain on the existing basic amenities in the region. This may create situation such as shortage of accommodation, insanitation etc. However, efforts will be to engage locals to the extent possible.
- Increased movement of traffic on the existing roads may lead to congestion, besides air and noise pollution, and safety concern. However, these would be minimal in the proposed activity.

The above impacts would be of diversified nature as primary or secondary, adverse or beneficial, local or regional, long-term or short term and reversible or irreversible. The impacts are classified and given in **Table 4.3.6.1**.

Table 4.3.6.1: Prediction of Qualitative Impacts on Socio-economic Environment

Parameter	Local	Regional	Direct	Indirect	Reversible	Irreversible
Employment	+	+	+	+	•	+
Income	+	+	+	+	•	+
Transport	+	•	+	•	•	+
Education	+	•	+	•	•	+
Medical facilities	+	•	+	•	•	+
Communication	+	+	+	•	•	+
Availability of fuel and electricity	+	+	+	+	•	+
Sanitation	+	•	+	•	•	+
Housing	+	•	+	•	•	+
Health	-	•	-	-	•	•
Recreation	+	•	•	+	•	+
Agriculture	-	•	-	•	-	-
Cost of living	-	•	•	-	•	+
Business	+	+	+	•	•	•
Per capita Income	+	+	+	•	•	•
Pollution	-	•	-	•	-	•

+ : Positive Impact

- : Negative Impact

• : Insignificant

Various social welfare measures have already been taken by the Refinery and these will be further expanded/ intensified under corporate social responsibility of the Company to ensure mitigation of the negative impacts, leading to improvement in quality of life of the people in the region. The details of CSR activities being carried out by the Refinery are given in Chapter 3.

4.4 Summary of Environmental Impacts and Mitigation Measures during Construction and Operation Phase

Summary of environmental impacts and mitigation measures during construction and operational phase of the proposed project are presented in **Table 4.4.1** and **4.4.2** respectively.

Table 4.4.1: Summary of Anticipated Adverse Environmental Impacts and Mitigation Measures during Construction Phase

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Loose soil at construction site	During monsoon season run off from construction site will be routed to a temporary sedimentation tank for settlement of suspended solids.	–
Air Quality	Increase in dust and NO_2 concentration	Leveling activity and heavy vehicular movement	Sprinkling of water in the construction area and on unpaved roads. Proper maintenance of vehicles will be done.	The impact will be low, as the main approach road will be tarred.
Noise	Increase in noise level	Construction equipment	Equipment will be kept in good condition to keep the noise level within the norms 90 dB(A).	Workers will be provided necessary protective equipment *e.g.* ear plug, earmuffs.
Terrestrial Ecology	Clearing of vegetation	Soil enabling activities	Landscaping and extensive plantation will be done.	-
Socio-economic	--	--	--	No land acquisition. No R&R issues involved.

Table 4.4.2: Summary of Anticipated Adverse Environmental Impacts and Mitigation Measures during Operational Phase

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
Wastewater	Deterioration of surface water quality	Discharge from various plant units	Wastewater shall be treated in the existing WWTF.	The entire effluent will be reused within the refinery
Air Quality	Increase in PM, SO_2 and NOx levels in ambient air	Vehicular emissions No stack emissions	Strict adherence to I&M of vehicles, Valid PUC	Requirement of truck movement is very less, hence no significant impact envisaged.

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
	contamination	storage facilities	of leachable material	Strict adoption of S&HWM Rules, 2016
Ecology				
a. Terrestrial	Impact on plant species	Nil	Nil	--
b. Aquatic	Impact on water bodies	Treated waste water from plant	The wastewater will treated in WWTF and and treated wastewater will be used for horticulture and dust suppression	As entire treated effluents will conform to prescribed limits, shall be reused within the refinery, no significant impact on aquatic life is expected.
Noise	Increase in noise levels in the plant area.	Equipment in main plant and auxiliaries.	Selected equipment will conform to noise levels prescribed by regulatory agencies. Provision of green belt and plantation would further help in attenuating noise.	Employees working in high noise areas would be provided earplugs/ earmuffs as protective device.
Demography and Socio-Economic	Strain on existing amenities like housing, water sources and sanitation, medical and infrastructure facilities.	Influx of people for proposed refinery employees as well as contractor's employees/ labourers.	Local population will be given preference in awarding work. No significant impact is envisaged. Additional facilities will be developed by the project proponents.	Overall socio-economic status of the area is expected to improve considerably.

4.5 Budgetary Allocation for Environmental Protection

Environment protection measured will be monitored and executed by the environmental management cell/department of the Nayara Energy. It is proposed to invest Rs. 10 Crores on pollution control, treatment and monitoring systems. In addition, Rs. 0.14 Crores per annum will be spent as recurring cost. The budgetary allocation for Environment Protection is given in **Table 4.5.1**.

Table 4.5.1: Budgetary Provision for Environmental Protection Measures

Sr. No.	Description of Item	Cost (Rs. in Crores)	Recurring Cost/year (Rs. in crores)
1	Air pollution control systems (Thermal Oxidiser)	7.5	0.1
2	Pre Treatment Unit in PP	2.5	0.04
	Total	10	0.14

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Chapter 5

Analysis of Alternatives (Technology and Site)

Chapter 5

Analysis of Alternatives (Technology and Site)

5.1 Site Alternatives and Analysis

Petrochemicals play a vital role in the functioning of virtually all key sectors of economy which includes agriculture, infrastructure, healthcare, textiles and consumer durables. Polymers provide critical inputs which enable other sector to grow. Petrochemical products cover the entire spectrum of daily use items ranging from clothing, housing, construction, furniture, automobiles, household items, toys, agriculture, horticulture, irrigation, and packaging to medical appliances.

India's strong economic growth will drive a phase of rapid demand growth in downstream plastics processing, with PP demand forecast of 8-9% for next 10 years as per market reports of various global petrochemical consultants. Rapid urbanisation, young demography and growing income supporting strong PP demand growth in India.

High population, relatively low per capita consumption and expected high economic growth should propel India's polymer consumption to new levels in future. Historically demand of PP has grown at 1.5 times of GDP growth in India and it is expected to grow at minimum 8% per year in future. Current PP demand of 5.5 MMTPA (year 2019-20 estimate) is expected to reach 8.8 MMTPA by year 2025-26 with this 8% growth rate. This demand growth likely to create need of 3.0 MMTPA PP capacity addition in India by 2025.

With continuous increase in population in the country and across the world, demand for various petrochemical products including polypropylene (PP) will continue to increase, that brings out the need for enhancing PP production to minimize the expanding gap between demand and supply.

In view of the above, the present proposal (ADP-1) has been prepared for production of 450 KTPA Polypropylene using the feedstock as well as other infrastructure facilities of the existing 20 MMTPA Refinery located at Vadinar village, Lalpur Taluka, District Devbhumi Dwarka.

The proposed modernization shall take place within the existing refinery complex, environmental clearance for which was already granted in 2008 at the same location for 60 MMTPA refinery capacity with petrochemical complex (however expansion revised to 46 MMTPA capacity, for which EC is under consideration).

The present proposal does not envisage any additional land procurement; therefore, all the aspects related to site selection have already been taken into consideration.

Area requirement for the proposed project ADP-1 has been optimized considering the space requirements of all the equipment, systems, buildings and structures required. Most of the existing infrastructural facilities and utilities shall be used for ADP-1 project. Necessary plant drainage system would be provided at the proposed refinery site. All facilities of the plant are laid out in close proximity to each other to the extent practicable so as to minimize the extent of land required. The layout also facilitates movement of men and materials between various facilities both during construction and also during subsequent operation and maintenance.

The following factors, which influence the site selection, have been favorable to select the proposed site:

- Availability of adequate unused land within the existing refinery premises for petro-chemical complex structures;
- Already available jetty and corridor for crude and water intake and disposal lines
- Adequate land being available for crude storage and other products;
- Suitability of land from topography, geological and environmental aspects;
- Proximity to highways for transport of heavy equipment as well as refinery products and petrochemical product;
- Environmentally suitable, absence of sensitive areas and major settlements; and
- Availability of existing infrastructure facilities.

5.2 Technology and Alternatives

Only two process units; PRU and Polypropylene units shall be required in this project, which shall be chosen/procured based on the latest and best technology available in the world, suiting the configuration of existing refinery operations. This shall ensure maximum conversion efficiency, production of superior grade products and minimum losses.

The company is continuously searching and evaluating state-of-the-art technologies, while those will give better operating returns but will ensure less resource consumption, lower emissions and cleaner products. The company is in regular touch with all leading Technology companies of the world to get the latest updates on the various existing and also evolving technologies.

Chapter 6

Environmental Monitoring Program

Chapter 6

Environmental Monitoring Program

Based on the baseline data collected on various environmental parameters and with the prediction of impacts, it is desirable to have an environmental monitoring program to establish the trend of various environmental parameters over a period of time and also to check their compliance with the discharge limits specified by the regulatory agencies. The details of the proposed environmental monitoring program are summarized below.

6.1 Existing Monitoring Programme with Future Requirements

The various components of the environment need to be monitored on regular basis as per the requirements of regulatory authorities as well as for trend monitoring of the pollutants levels. For the proposed ADP-1 Project, the Environmental Management Cell (EMC) of existing refinery will take care of all the aspects related to environmental compliance required during the construction and operational phase of the project.

The EMC will work out a schedule for monitoring, and will meet regularly to review the effectiveness of the EMP implementation. The data collected on various EMP measures would be reviewed by this committee and if needed, corrective action will be formulated for implementation. EMC will form short term and long term plans for environmental issues, which will require monitoring and effective implementation.

Monitoring of environmental components during operation phase is a part and parcel of the environmental mitigation measures. Only frequent monitoring can assess the functioning and efficacy of all pollution control equipment. Thus the project proponent has to ensure the monitoring through NABL accredited laboratory for various environmental quality parameters of air, water, soil, and noise level in the plant as well as in the surrounding impact zone. For this purpose, post project monitoring plan is suggested, which the project proponent shall follow for the existing refinery along with ADP-1 project.

Monitoring activity is mainly envisaged covering the following aspects:

- Air Quality (stack emissions & ambient air including fugitive emissions)
- Water and Effluent Quality
- Soil Quality
- Ecology
- Noise Levels
- Green Belt Development
- Social Welfare Activities Undertaken

The environmental quality-monitoring program will be carried out in the impact zone with suitable sampling stations and frequency for environmental parameters with respect to different environmental components.

Details of existing environmental monitoring programme including number of sampling locations, parameters to be monitored, frequency of monitoring done by Nayara Energy Limited for the existing 20 MMTPA refinery and additional requirement is given in **Table 6.1**. Since the proposed project is very small in comparison of the existing refinery and also it will utilize almost all the infrastrutural facilities and utilities, the envirinmental monitoring program of existing refinery shall take care.

Table 6.1: Existing Environmental Monitoring Programme with Additional Requirement for the ADP-1

Sr. No	Environmental Monitoring	Location	Parameters	Frequency	Additional Requirement for ADP-1 Project
Offline Environmental Monitoring Program (through NABL Accredited Laboratory)					
1.	Ambient Air Quality	4 Locations	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, Benzene and Benzo(α)Pyrene	Once a week	Nil
2.	Emission Source	All Stacks	PM, SO_2, NOx, CO, Ni and Vanadium	Continuous / Once in a month manually	Nil
3.	Surface Water	Sinhan Dam Phulzar River (Monthly in the season)	pH, colour, odour, DO, BOD, TDS, hardness, Cl, F, SO_4, alkalinity, NO_3, Ca, Mg, Na, K, Cu, Cr, Cd, Phenols, Pb, Zn, O&G, total coliforms	Once in a Month	Nil
4.	Ground water	9 Locations /villages	As per the parameters specified under IS:10500:2012; and ground water levels	Six monthly	No additional location
5.	Ambient Noise	9 location in which 4 locations at AAQ stations	Noise level in dB(A)	Once in a Month	Few additional locations in proximity to ADP-1 Units
6.	Soil	-	Colour, textural class, grain size, distribution, pH, EC, bulk density, porosity, infiltration rate, moisture retention capacity, wilting co-efficient, organic matter Na, N, K, PO_4, SO_4, SAR,	Once in Six Months	Nil

			base exchange capacity, metals		
7.	Ecology	-	Vegetation density and Bio Diversity	Once in a Year within refinery; once in 3 years within 10 km radius area	Nil
8.	Discharge to Sea	Cooling tower blow down and desalination plant brine	Sea water quality parameters	Once in a Month	Nil
9.	Treated Effluent	Final Sump	pH, TSS, Color, BOD, COD, Heavy metals (Arsenic, Total Chromium, Hexavalent Chromium, Iron, Copper) etc.	Once in a Month	Individual w/w stream characterization (quarterly)
10.	Ground Water along the pipe line corridor	-	As per the parameters specified under IS:10500:2012; and ground water levels	Once in a Month	Nil
11.	Marine Water Quality Monitoring	Near Intake and Outfall Locations	Sea Water Quality Parameters, Phytoplankton diversity and biomass, Zooplankton diversity and biomass, Corals, Macro-benthos and Lethal toxicity test etc.	Once in a month	Nil
Online Environmental Monitoring Program (In-house Facility)					
1.	Ambient Air Quality	2 Nos.	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, O_3, NH_3	Continuous	Nil
2.	Emission Source	All process units	PM, SO_2, NOx, CO	Continuous	Ocassionally, VOCs from thermal oxidizer
3.	Meteorology Data	1 Met station at refinery site	Wind speed, wind direction, temperature, relative humidity and rainfall	Continuous	Nil
4.	Discharge to Sea	Outlet discharge point	Temperature and O&G	Continuous	Nil
5.	Treated Effluent	Outlet discharge at ETP	pH, Oil & Grease, BOD, COD, TSS, Phenol, Ammonia	Continuous	Nil

Note: All the parameters are being monitored as per applicable standard methods and the same shall be followed for ADP-1 project also.

Offline monitoring for various parameters is carried out through NABL accredited laboratory, whereas online monitoring is done by in-house facility.

It is proposed to develop in-house monitoring capability for all the offline parameters in due course of time (with NABL accreditation), which will meet the requirement of entire refinery complex after proposed project.

6.2 Staff Requirement for Environment Management

Considering the importance of the pollution control and environmental protection, a group of personnel is already identified for the existing plant, which will take care of future requirement also with suitable technical and support staff. Organization structure of environmental management department for the existing plant is shown in **Fig. 6.1**, which will be suitably augmented by employing relevant subject/discipline experts at an appropriate time.

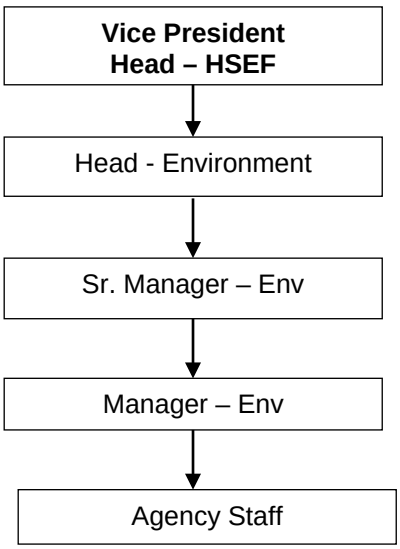

Fig. 6.1: Existing Organizational Structure of Environment Management Department at Nayara Refinery

Refinery has well-established Environment Management Cell for ensuring compliance with all the Environment Clearance conditions. The Environment Management Cell is in position, headed by senior executive and reports directly to the Director and Head of the Refinery. Technical qualification of staff is as shown in T**able 6.2**. Head HSEF Directly reports to Director and Head of the Refinery.

Table 6.2: Details Environment Management Cell at Nayara Refinery

Sr. No.	Name of the Person	Designation	Technical Qualification
1	Mr. P. R. Dixit	VP & Head- HSEF	M. Tech Environment
2	Ms. Asmita Patel	Head Environment	M. Tech Environment
3	Ms. Priya Ayengar	Sr. Manager Environment	B.E Electrical & PG Diploma in Environment & Sustainability
4	Mr. Harshit Shah	Manager Environment	B.E Electrical & PG Diploma in Environment & PG Diploma Safety
5	Mr. Ravirajsinh Gohil	Manager Environment	M. Tech Environment

In addition, the Company also has Legal Compliance Management Portal to ensure compliance of all the conditions, which is reviewed time to time by Director and Head of Refinery & Head-HSEF and Head-Environment.

The company has a full-fledged safety department to look after the safety issues of the plant. The same shall be followed in future expansion also.

The environmental management team shall be expanded with ADP-1 project to take care of all the environmental issues.

6.3 Operation and Maintenance of Pollution Control System

Normally persons engaged in production are also entrusted with operation and maintenance of pollution control systems. This may result in neglect of these systems as priority is given to production equipment. In view of this and the requirement of ensuring emission, ambient air and water quality standards, an officer of the plant shall be made responsible for the effective functioning of all pollution control systems. He will report to the Head of the Maintenance Department. Whenever required, he will draw crew from the main plant maintenance team for maintenance of pollution control system.

6.4 Budgetary Provisions

The budget allocated fot the existing refinery shall take care of the environmental monitoring requirement for the proposed ADP-1 project. Additional requirement, if any, shall also be taken care by the Company.

6.5 Submission of Monitoring Reports to Regulatory Authorities

As required, the status of environmental clearance stipulation implementation will be submitted to regulatory authorities in soft copy by 1st December for the period from April to September and by 1st June for the period from October to March of every year. These reports will be put up on company's website as per their procedure and will be updated every six months. The conventional pollutants will be monitored on monthly basis and reports will be submitted to SPCB, as per the requirements.

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Chapter 7

Additional Studies

Chapter 7

Additional Studies

This chapter deals with two important components of the EIA Report as:

Part A: Risk Assessment Analysis

Part B: Public Consultation

Part A: Risk Assessment Analysis

7.1 Introduction

Risk Assessment (RA) study comprises identification of hazards, consequence analysis due to the accidental release of hazardous chemicals, quantification of risk based on failure probability of equipment, mitigation measures to reduce risk and delineation of disaster management plan. The risk assessment study for Asset Development Project–1 (ADP-1) requires a thorough knowledge of credible accident scenarios, failure probability, vulnerability of population and atmospheric conditions at the site. The consequence analysis includes the computation of damage distances for fire, explosion and toxic release scenarios. The quantification of risk comprises individual as well as societal risk to the in-plant and surrounding population. The mitigation measures are recommended based on the outcome of the risk quantification.

7.1.1 Objectives of the Study

Following are the objectives of the study:

- Study of past accident information to identify worst scenarios
- Hazard identification through computation of fire, explosion and toxicity indices (FETI)
- Generation of credible and worst case scenarios for accidental release of hazardous chemicals in the proposed ADP-1 project
- Computation of damage distances through consequence analysis for various heat loads and pressure waves at different atmospheric conditions

- Quantification of risk through individual and societal contours based on population data
- Assessment of individual and societal risk against the risk acceptability criteria relevant to the situation
- Recommendations for risk mitigation measures based on the study
- Preparation of Disaster Management Plan (DMP) comprising on-site and off-site emergency scenarios

7.1.2 Components of Risk Assessment

The components of a risk assessment study are:

- Hazard identification
- Consequence analysis
- Quantification of risk
- Recommendations for risk mitigation
- Delineation of Disaster Management Plan

7.2 Past Accident Data Analysis

Analysis of events arising out of the unsafe conditions is one of the basic requirements for ensuring safety in any facility. The data required for such an analysis has either to be generated by monitoring and/or collected from the records of the past occurrences. This data, when analysed, helps in formulation of the steps towards mitigation of risk from handling of hazards. Trends in safety of various activities can be evaluated and actions can be planned accordingly in order to improve the overall safety of the facility.

Data analysis helps in correlating the causal factors and the corrective steps to be taken for controlling the accidents. It is, therefore, of vital importance to collect the data methodically, based on potential incidents, sections involved, causes of failure and the preventive measures taken. This helps to face future eventualities with more preparedness. Following are a few accidents occurred in the past at the petroleum industries.

Explosion in Repsol-YPF Petrochemicals Refinery, Puertollano, Spain, August 14, 2003

On 14 August 2003, several petroleum tanks exploded causing a major fire at the Repsol-YPF refinery in Puertollano, Castilla-La Mancha, Spain. Eight workers died and many others were seriously injured in the accident. The plant has suffered at least 10 serious accidents in the past 20 years, causing significant number of deaths and injuries.

Explosion in BP's Texas City Refinery in Texas City, Texas, March 23, 2005

BP's Texas City refinery is one of the largest refinery in the state. On March 23, 2005, the explosion occurred in an isomerisation unit killing 15 workers and injuring more than 170. As per the report published, overfilling of the raffinate splitter, overheating, and subsequent over pressurization caused liquids carrying over out of the top of the stack, flowing down the stack and its accumulation on the ground. This causes a formation of significant amount of vapour cloud which was ignited due to running engine of contractor's pickup truck.

Buncefield Oil Storage and Transport Incident, UK, 11 December 2005

On Sunday 11 December 2005, a series of explosions and subsequent fire destroyed large parts of the Buncefield oil storage and transfer depot at Hemel Hempstead in UK. The main explosion took place at around 6:00 AM followed by a large fire that engulfed 23 large fuel storage tanks over a high proportion of the Buncefield site. No fatalities were reported, however, more than 43 people were injured. More than 2000 people had to be evacuated from their homes and sections of the M1 motorway were closed. The accident caused widespread damage to neighbouring properties. The fire burned for five days, destroying most of the site and emitting a large plume of smoke into the atmosphere that dispersed over southern England.

Lanzhou Petrochemical Company Accident, June 28, 2006

On June 28th, 2006 an explosion broke out in CNPC Lanzhou Petrochemical Company Refinery Plant, Gansu province, China. The accident caused one death and ten injuries. The preliminary investigation showed that the accident was caused due to leakage of gas from fluid catalytic cracking unit.

Oil Storage Depot Accident, Indian Oil Corporation Limited, Jaipur, October 29, 2009

A massive fire broke out on 29th October at an oil storage depot in the western state of Rajasthan state killing eleven people and injuring more than 135. The continuous oil leakage for 80 mins formed a huge vapour cloud which exploded before the fire ignited and spread. The fire broke out around 19:30 local time at the oil storage depot run by Indian Oil Corporation (IOC) Ltd. and was visible from over 25 kilometres away.

IOCL Refinery Accident, Panipat, January 2, 2018

Accidentally released propylene gas from naphtha cracker unit exploded killing one worker and seriously injuring more than two maintenance staff personnel. The workers were engaged in maintenance of a valve from which propylene gas was leaked causing a high volume blast at 12.50 pm. A major fire broke out in the unit. The explosion blew off the roof of the plant.

7.3 Hazard Identification

Identification of hazards is an important step in risk assessment study as it leads to the generation of accidental scenarios. Once a hazard has been identified, it is necessary to evaluate the risk to plant personnel and neighbouring community arising due to handling of identified hazards. The following points are taken into account while identifying hazards.

- Location of process unit facilities involving hazardous chemicals
- The types and design of process units
- The quantity of hazardous chemical that could be involved in an airborne release and
- The properties of the hazardous chemical

7.3.1 Fire and Explosion Index (FEI)

The Fire and Explosion Index (FEI) is useful in identifying hazardous materials and risks arising due to the handling of hazardous materials. The FEI estimates the global risk associated with a unit in which hazardous materials are processed and classifies the units according to their general level of risk. The FEI covers aspects related to the intrinsic hazard of materials, the quantities handled and operating conditions. This factor gives index value for the area which could be affected by an accident. The method for evaluation of FEI involves following stages.

- Selection of pertinent process unit which can have serious impact on overall safety of the plant
- Determination of Material Factor (MF): The factor for a given substance in the process unit gives intrinsic potential to release energy in case of fire or an explosion. Material Factor can be directly obtained from Dow's Fire and Explosion Index Hazard classification Guide of American Institute of Chemical Engineers, New York. The factor can also be evaluated from NFPA indices of danger, health, flammability and reactivity
- Determination of Unit Hazard Factor: The Unit Hazard Factor is obtained by multiplication of General Process Hazard (GPH) factor and Special Process Hazard (SPH) factor. The GPH factor is computed according to presence of exothermic reactions and loading and unloading operations. The penalties due to each of these reactions / operations are summed up to compute GPH factor. Similarly, the SPH factor can be evaluated for the operations close to flammable range or operating pressures different from atmospheric pressure. Penalties of these operations for both factors can be obtained from Dow's EFI index form.

Fire and explosion index is then calculated as the product of Material Factor (MF) and Unit Hazard Factor. Degree of hazards based on FEI and TI is given in the following **Tables 7.1** and **7.2**.

Table 7.1: Degree of Hazards Based on FEI

FEI Range	Degree of Hazard
0 – 60	Light
61-96	Moderate
97 - 127	Intermediate
128 - 158	Heavy
159 and Above	Severe

Table 7.2: Degree of Hazards Based on TI

TI Range	Degree of Hazard
0 – 5	Light
5 – 10	Moderate
Above 10	High

Preventive and protective control measures are recommended based on degree of hazard. Therefore, FEI indicates the efforts to be taken to reduce risks for a particular unit. The fire and explosion indices computed for various process equipment in the proposed ADP-1 project are given in **Table 7.3**.

Table 7.3: Fire, Explosion and Toxicity Indices

Unit	Reactor/Vessel	FEI/TI	Nature of Hazard
FCCU	Reactor	92	Moderate
	Main Fractionator	41	Light
LPG Treaters	UMU-1 LPG vessel	93	Moderate
	UMU-2 LPG Vessel	105	Intermediate
Propylene Recovery Unit	Depropanizer	67	Moderate
	Splitter	75	Moderate
Polypropylene Unit	Reactor	68	Moderate
Tankages	Propylene Bullet	171	Severe

7.4 Maximum Credible Accidents (MCA) Analysis

The MCA analysis encompasses defined techniques to identify the hazards and compute the consequent effects in terms of damage distances due to heat radiation, toxic releases, vapour cloud explosion etc. A list of probable or potential accidents of the major units in the facility arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. Flow chart of accidental release of hazardous chemicals is presented in **Fig. 7.1**.

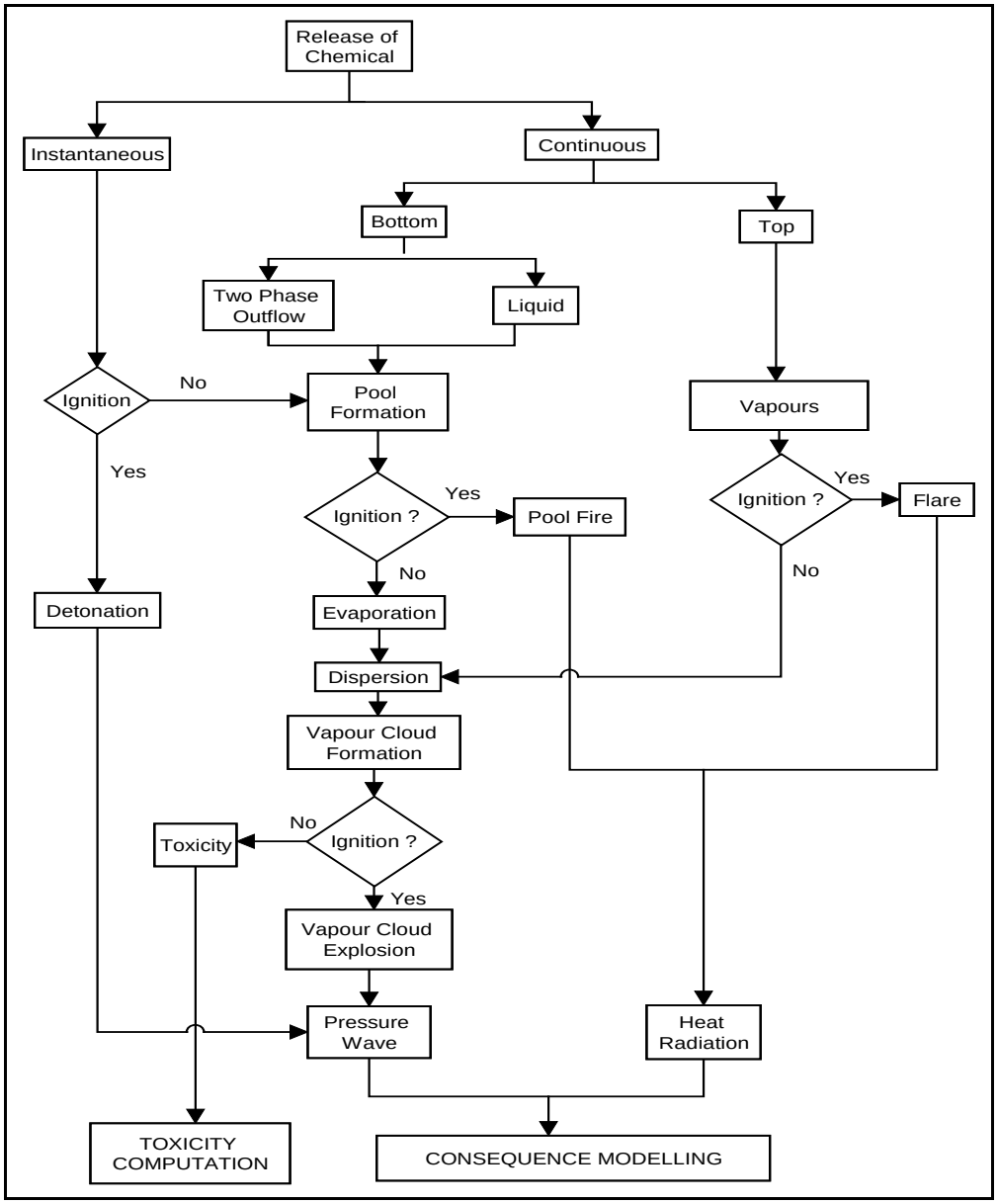

Fig.7.1: Accidental Release of Chemicals: A Scenario

Hazardous substances can cause damage on a large scale if they are accidentally released. The extent of the damage is dependent upon the nature of the release and the physical state of the material. In the present study, the consequences for flammable hazards are considered and the damages caused due to such releases are assessed at different combinations of weather conditions to simulate worst possible scenario.

The following steps are involved in the MCA analysis:

- Identification of potential hazardous sections and representative failure cases
- Visualisation of release scenarios with recourse to consequence analysis
- Damage distance computations for the released cases

The flammable substances on release may cause fire and/or explosion causing possible damage to the surrounding area. The extent of damage depends upon the nature of the release. The release of flammable materials and subsequent ignition result in heat radiation wave or pressure waves depending upon the flammability and its physical state. Damage distances due to release of hazardous materials depend on atmospheric stability and wind speed. It is important to visualize the consequence of the release of such substances and the damage caused to the surrounding areas.

Computation of damage distances are carried out at various atmospheric stability conditions for various wind velocities and the result is tabulated. Pasquill-Giffard atmospheric stability classes with corresponding weather conditions are listed in **Table 7.4**.

The probable worst case scenarios for the proposed expansion facility can be an accidental release from a small hole (25 mm or 50 mm in size) of a process equipment, storage tank or from a pipeline. The hole sizes of 25 and 50 mm have been considered as per CPR 18 E (Guidelines for quantitative risk assessment - Purple Book) standards.

Table 7.4: Pasquill – Giffard Atmospheric Stability

Sr. No.	Stability Class	Weather Conditions
1.	A	Very unstable – sunny, light wind
2.	A/B	Unstable - as with A only less sunny or more windy
3.	B	Unstable - as with A/B only less sunny or more windy
4.	B/C	Moderately unstable – moderate sunny and moderate wind
5.	C	Moderately unstable – very windy / sunny or overcast / light wind
6.	C/D	Moderate unstable – moderate sun and high wind
7.	D	Neutral – little sun and high wind or overcast / windy night
8.	E	Moderately stable – less overcast and less windy night thand
9.	F	Stable – night with moderate clouds and light / moderate wind
10.	G	Very stable – possibly fog

7.4.1 Fire and Explosion Scenarios

Combustible materials within their flammable limits may ignite and burn if exposed to an ignition source of sufficient energy. On process plants, this normally occurs as a result of a leakage or spillage. Depending on the physical properties of the material and the operating parameters, the combustion of material in a plant may take on a number of forms like jet fire, flash fire, pool fire, vapour cloud explosion and BLEVE.

Jet Fire

Jet fire occurs when flammable material of a high exit velocity ignites. In process industries this may be due to equipment failure or an accidental ejection of flammable material from a vessel, pipe or pipe flange may give rise to a jet fire and in some instances the jet flame could have substantial "reach". Depending on wind speed, the flame may tilt and impinge on pipeline, equipment or structures. The thermal radiation from these fires may cause injury to people or damage equipment some distance from the source of the flames.

Flash Fire

A flash fire is the non-explosive combustion of a vapour cloud resulting from a release of flammable material into the open air, which after mixing with air, ignites. A flash fire results from the ignition of a released flammable cloud in which there is essentially no increase in combustion rate. The ignition source could be electric spark, a hot surface, and friction between moving parts of a machine or an open fire.

Flash fire may occur due to its less vapour temperature than ambient temperature. Hence, as a result of a spill, they are dispersed initially by the negative buoyancy of cold vapour and subsequently by the atmospheric turbulence. After the release and dispersion of the flammable fuel the resulting vapour cloud is ignited and when the fuel vapour is not mixed with sufficient air prior to ignition, it results in diffusion fire burning. Therefore the rate at which the fuel vapour and air are mixed together during combustion determines the rate of burning in the flash fire.

The main dangers of flash fire are radiation and direct flame contact. The size of the flammable cloud determines the area of possible direct flame contact effects. Radiation effects on a target depend on several factors including its distance from the flames, flame height, flame emissive power, local atmospheric transitivity and cloud size. Most of the time, flash combustion lasts for no more than a few seconds.

Pool Fire

Releases of hydrocarbons in the absence of immediate ignition would form an unconfined pool, which on ignition would result in a pool fire. Radius of pool depends upon mass flow rate, ambient temperature; heat of vaporization of material released, vapour

pressure of material released and discharge duration. Emissive power generated from the pool surface depends upon pool burning rate, heat of combustion of release material, atmospheric transitivity and area of pool.

The pool fire being either tank or bund fire consists of large volumes of flammable material at atmospheric pressure burning in an unconfined space. The flammable material will be consumed at the burning rate depending on factors including the prevailing winds. During combustion heat will be released in the form of thermal radiation. Temperature close to the flame centre will be high but will reduce rapidly to tolerable temperatures over a relatively short distance. Any plant building or persons close to the fire or within the intolerable zone will experience burn damage with the severity depending on the distance from the fire and the time exposed to the heat of the fire. In the event of a pool fire the flames will tilt according to the wind speed and direction. The flame length and tilt angle affect the distance of thermal radiation generated.

Vapour Cloud Explosion

The Vapour Cloud Explosion (VCE) begins with a release of a large quantity of flammable vaporizing liquid or gas from a storage tank, transport vessel or pipeline producing a dangerous overpressure. These explosions follow a well-determined pattern. There are basically four features, which must be present for an effective vapour cloud explosion to occur with an effective blast. These are:

- First, the release material must be flammable and at a suitable condition of temperature and pressure which depends on the chemical. The materials which come under this category, range from liquefied gases under pressure (e.g. butane, propane); ordinary flammable liquids (e.g. cyclohexane, naphtha) to non-liquefied flammable gases (e.g. ethylene, acetylene)
- Second, before the ignition, a cloud of sufficient size must have been formed. Normally ignition delays of few minutes are considered the most probable for generating the vapour cloud explosions
- Third, a sufficient amount of the cloud must be within the flammable range of the material to cause extensive overpressure
- Fourth, the flame speed determines the blast effects of the vapour cloud explosions, which can vary greatly
- The flammable content of a gas cloud is calculated by three-dimensional integration of the concentration profiles, which fall within the flammable limits. If the gas cloud ignites, two situations can occur, namely non-explosive combustion (flash fire) and explosive combustion (flash fire followed by explosion)

BLEVE

If the liquid is stored under pressure at a temperature above its boiling point, the initial physical explosion that breaks the receptacle produces a sudden decompression giving rise to a massive evaporation of the saturated liquid. This kind of evaporation is known as BLEVE. The explosion is of great destructive power due to the high increase in pressure caused by the sudden incorporation of liquid into the gas phase. The ignition of BLEVE produces a mass of gases at high temperature known as 'fireball' with significant thermal effects. Historically, BLEVEs have been produced with some frequency and have almost caused human casualties.

Lower and Upper Flammability Limit

In case of any spillage and leakages of hydrocarbons / flammable material, probability of getting ignited is depending on whether the air borne mixture is in the flammable region. The lower flammability limit corresponds to minimum proportion of combustible vapour in air for combustion. The upper flammability limit ccorresponds to maximum proportion of combustible vapour in air for combustion and the concentration range lying between the lower and the upper limit is called as flammable range.

7.4.2 Models for the Calculation of Heat load and Shock Waves

If a flammable gas or liquid is released, damage resulting from heat radiation or explosion may occur on ignition. Models used in this study for the effects in the event of the ignition of a gas cloud will be discussed in succession. These models calculate the heat radiation or peak overpressure as a function of the distance from the torch, the ignited pool or gas cloud. The physical significance of the various heat loads is depicted in **Table 7.5**.

Table 7.5: List of Damages Envisaged at Various Heat Loads

Sr. No.	Heat loads (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	Human Injury
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec
2	25.0	Minimum energy required to ignite wood	50% Lethality in 1 min. Significant injury in 10 sec
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected equipment	--
4	12.5	Minimum energy required to melt plastic tubing	1% lethality in 1 min
5	4.0	--	First degree burns, causes pain for exposure longer than 10 sec
6	1.6	--	Causes no discomfort on long exposures
Source: Techniques for assessing industrial hazards by world bank			

7.4.3 Model for Pressure Wave

A pressure wave can be caused by gas cloud explosion. The following damage criteria are assumed as a result of the peak overpressure:

- 0.03 bar overpressure wave is taken as the limit for the occurrence of wounds as a result of flying fragments of glass
- Following assumptions are used to translate an explosion in terms of damage to the surrounding area:
  - Within the contour area of the exploding gas cloud, Casualties are due to burns or asphyxiation. Houses and buildings in this zone will be severely damaged
  - In houses with serious damage, it is assumed that one out of eight persons present will be killed as a result of the building collapse. Within the zone of a peak over pressure of 0.3 bar the risk of death in houses is 0.9 × 1/8 = 0.1125, and in the zone with a peak over pressure of 0.1 bar the probability of death is 0.1 × 1/8 = 0.0125, i.e. one out of eighty people will be killed

The significance of the peak over pressures 0.3 bar, 0.1 bar, 0.03 bar and 0.01 bar are depicted in **Table 7.6**.

Table 7.6: Damage Criteria for Pressure Waves

Human Injury		Structural Damage	
Peak Over Pressure (bar)	**Type of Damage**	**Peak Over Pressure (bar)**	**Type of Damage**
5-8	100% lethality	0.3	Heavy (90% damage)
3.5-5	50% lethality	0.1	Repairable (10% damage)
2-3	Threshold lethality	0.03	Damage of Glass
1.33-2	Severe lung damage	0.01	Crack of windows
1-1.33	50% Eardrum rupture	-	-
Source: Marshall, V.C. (1977)' How lethal are explosives and toxic escapes'.			

7.4.4 Computation of Damage Distances

Damage distances for the accidental release of hazardous materials have been computed at 2F, 3D and 5D weather conditions. In these conditions, 2, 3 and 5 are wind velocities in m/s and F and D are atmospheric stability classes. These weather conditions have been selected to accommodate worst case scenarios to get maximum effective distances. DNV based **PHAST 6.51**, software has been used to carryout consequence analysis. The computed damage distances for different units of proposed ADP-1 project are described in **Table 7.7**.

Table 7.7: Computed Damage Distances for Different Process Units

Equipment	Source Strength (kg/sec)	Leak Size (mm)	Weather	Damage Distance (m)										
				Jet Fire			Flash Fire at LFL conc.	Pool Fire			VCE: Over pressure			IDLH conc. distance
				37.5 kW/m²	12.5 kW/m²	4.0 kW/m²		37.5 kW/m²	12.5 kW/m²	4.0 kW/m²	0.3 bar	0.1 bar	0.01 bar	
FCCU														
Fractionator	0.37	25	2F	-	8	10	5	-	-	-	-	-	-	-
			3D	-	-	10	5	-	-	-	-	-	-	-
			5D	-	-	10	4	-	-	-	-	-	-	-
	1.48	50	2F	-	17	22	9	-	-	-	13	16	45	-
			3D	12	17	22	8	-	-	-	13	16	42	-
			5D	14	18	22	7	-	-	-	13	15	41	-
Wet gas compressor	0.42	25	2F	-	9	11	5	-	-	-	-	-	-	-
			3D	-	9	11	5	-	-	-	-	-	-	-
			5D	-	9	12	5	-	-	-	-	-	-	-
	1.70	50	2F	-	18	24	10	-	-	-	23	27	59	-
			3D	14	19	24	9	-	-	-	23	26	57	-
			5D	16	20	24	8	-	-	-	13	16	45	-
LCO Stripper	39.35	25	2F	-	-	11	5	-	-	-	-	-	-	-
			3D	-	-	11	5	-	-	-	-	-	-	-
			5D	-	8	11	4	-	-	-	-	-	-	-
	1.57	50	2F	-	17	22	10	-	-	-	23	26	57	-
			3D	13	18	22	9	-	-	-	13	16	44	-
			5D	15	19	23	8	-	-	-	13	16	42	-
Stripper	13.62	25	2F	39	49	62	95	38	38	38	115	119	306	-
			3D	48	52	59	88	49	49	49	124	129	298	-
			5D	55	59	65	81	52	52	52	125	129	300	-

Equipment	Source Strength (kg/sec)	Leak Size (mm)	Weather	Damage Distance (m)										
				Jet Fire			Flash Fire at LFL conc.	Pool Fire			VCE: Over pressure			IDLH conc. distance
				37.5 kW/m²	12.5 kW/m²	4.0 kW/m²		37.5 kW/m²	12.5 kW/m²	4.0 kW/m²	0.3 bar	0.1 bar	0.01 bar	
	54.48	50	2F	74	95	123	187	51	53	56	209	218	338	-
			3D	88	97	117	113	54	55	57	136	146	337	-
			5D	99	108	123	178	68	69	70	205	210	352	-
Debutanizer	11.24	25	2F	33	44	60	43	-	-	-	86	95	212	-
			3D	35	46	60	40	-	-	-	97	104	209	-
			5D	39	48	59	39	-	-	-	106	112	214	-
	44.99	50	2F	60	81	114	87	-	-	-	107	114	294	-
			3D	62	83	113	96	-	-	-	113	115	286	-
			5D	69	85	108	97	-	-	-	115	119	289	-
Gasoline Splitter	0.32	25	2F	-	8	10	5	-	-	-	-	-	-	-
			3D	-	8	10	5	-	-	-	-	-	-	-
			5D	-	8	11	4	-	-	-	-	-	-	-
	1.31	50	2F	6	17	22	9	-	-	-	23	26	57	-
			3D	9	17	22	9	-	-	-	13	16	45	-
			5D	15	19	22	8	-	-	-	13	16	42	-
Medium Gasoline Splitter	0.36	25	2F	-	8	11	5	-	-	-	-	-	-	-
			3D	-	9	11	5	-	-	-	-	-	-	-
			5D	-	10	12	5	-	-	-	-	-	-	-
	1.46	50	2F	9	18	23	11	-	-	-	24	27	61	-
			3D	13	18	23	10	-	-	-	23	27	58	-
			5D	17	20	24	9	-	-	-	13	16	46	-
Oil feed	1.57	25	2F	-	18	23	9	-	-	-	13	16	46	-
			3D	13	18	23	8	-	-	-	13	16	43	-

Equipment	Source Strength (kg/sec)	Leak Size (mm)	Weather	Damage Distance (m)										
				Jet Fire			Flash Fire at LFL conc.	Pool Fire			VCE: Over pressure			IDLH conc. distance
				37.5 kW/m²	12.5 kW/m²	4.0 kW/m²		37.5 kW/m²	12.5 kW/m²	4.0 kW/m²	0.3 bar	0.1 bar	0.01 bar	
			5D	16	19	23	7	-	-	-	13	16	42	-
	6.30	50	2F	8	35	45	21	-	-	-	47	54	120	-
			3D	-	36	46	20	-	-	-	36	43	104	-
			5D	30	37	46	18	-	-	-	36	42	101	-
Reactor	0.77	25	2F	-	11	15	5	-	-	-	12	14	33	-
			3D	-	12	15	5	-	-	-	-	-	-	-
			5D	-	12	15	4	-	-	-	-	-	-	-
	3.10	50	2F	19	24	30	11	-	-	-	24	28	66	-
			3D	19	25	31	10	-	-	-	24	27	63	-
			5D	21	26	31	9	-	-	-	23	27	61	-
Main Fractionators	0.40	25	2F	-	8	11	5	-	-	-	-	-	-	-
			3D	-	8	11	4	-	-	-	-	-	-	-
			5D	-	9	11	4	-	-	-	-	-	-	-
	1.62	50	2F	37	18	23	8	-	-	-	13	16	46	-
			3D	13	19	23	8	-	-	-	13	16	44	-
			5D	16	20	24	7	-	-	-	13	15	42	-
Treaters														
LPG vessels 1	13.4	25	2F	36	48	67	66	-	-	-	167	184	348	-
			3D	38	50	66	60	-	-	-	155	170	315	-
			5D	44	51	61	61	-	-	-	145	159	300	-
	53.1	50	2F	66	90	127	157	-	-	-	211	243	594	-
			3D	69	92	124	143	-	-	-	257	274	574	-
			5D	79	92	115	155	-	-	-	293	307	601	-

Equipment	Source Strength (kg/sec)	Leak Size (mm)	Weather	Damage Distance (m)										
				Jet Fire			Flash Fire at LFL conc.	Pool Fire			VCE: Over pressure			IDLH conc. distance
				37.5 kW/m²	12.5 kW/m²	4.0 kW/m²		37.5 kW/m²	12.5 kW/m²	4.0 kW/m²	0.3 bar	0.1 bar	0.01 bar	
LPG vessels 2	16.1	25	2F	39	52	71	60	-	-	-	145	161	146	-
			3D	41	53	71	56	-	-	-	144	159	144	-
			5D	45	55	70	56	-	-	-	143	158	143	-
	64.5	50	2F	70	95	134	138	-	-	-	220	250	576	-
			3D	72	97	133	132	-	-	-	261	273	562	-
			5D	80	100	129	138	-	-	-	284	299	577	-
Propylene Recovery Unit														
Depropanizer	0.96	25	2F	-	13	16	8	-	-	-	21	15	12	-
			3D	-	13	16	7	-	-	-	21	15	12	-
			5D	-	13	16	7	-	-	-	20	14	12	-
	3.84	50	2F	21	27	34	17	-	-	-	64	50	45	-
			3D	-	27	34	16	-	-	-	52	40	35	-
			5D	23	28	34	15	-	-	-	51	39	34	-
Splitter	12.47	25	2F	35	47	64	50	-	-	-	-	-	-	-
			3D	37	48	63	47	-	-	-	-	-	-	-
			5D	41	50	63	47	-	-	-	-	-	-	-
	49.89	50	2F	63	85	120	119	-	-	-	-	-	-	-
			3D	65	87	119	113	-	-	-	-	-	-	-
			5D	72	90	115	117	-	-	-	-	-	-	-
Polypropylene Unit														
Reactor	2.93	25	2F	19	24	31	17	-	-	-	45	50	63	-
			3D	20	24	30	15	-	-	-	34	39	51	-
			5D	21	25	30	14	-	-	-	34	38	50	-

Equipment	Source Strength (kg/sec)	Leak Size (mm)	Weather	Damage Distance (m)										
				Jet Fire			Flash Fire at LFL conc.	Pool Fire			VCE: Over pressure			IDLH conc. distance
				37.5 kW/m²	12.5 kW/m²	4.0 kW/m²		37.5 kW/m²	12.5 kW/m²	4.0 kW/m²	0.3 bar	0.1 bar	0.01 bar	
	18.37	50	2F	43.18	59	75	55	-	-	-	145	159	199	-
			3D	44.46	58	74	52	-	-	-	143	156	191	-
			5D	46.99	57	74	51	-	-	-	133	146	182	-
Tankages														
Propylene Bullet	14.02	25	2F	37	52	68	62	-	-	-	156	172	216	-
			3D	36	50	67	58	-	-	-	154	169	208	-

7.5 Risk Quantification

Risk is quantified in terms of probability of occurrence of hazardous event and magnitude of its consequences. The consequence modelling was carried out in order to assess the extent of damage by visualizing accidental release scenarios for various equipment of the proposed ADP-1 project. The risk to the human due to accidental release scenarios is represented in two ways viz. individual risk and societal risk which are described in subsequent sections.

7.5.1 Individual Risk

The individual risk (IR) level is more specifically defined as the Individual Risk Per Annum (IRPA), which is the calculated annual risk loading to a specific individual or group of individuals. Clearly this depends on the amount of time in a year that the individual spends in different risk areas. The individual risk calculation takes account of the fact that people move from one place to another.

When calculating individual risk from major accident scenarios, it is normal to take account of protection by buildings. Individual risk is typically depicted as contour plots on overall plot plan of a facility, the risk level falling off rapidly as one moves away from the source of the leak / epicentre of potential explosions.

7.5.2 Societal Risk

Societal risk is used in quantified risk assessment (QRA) studies and is depicted on a cumulative graph called an F/N curve. The horizontal axis is the number of potential fatalities, N. The vertical axis is the frequency per year that N or more potential fatalities could occur, F. This risk indicator is used by authorities as a measure for the social disruption in case of large accidents.

It is normal to take account of protection by buildings, and people's response. For large toxic release models, alarm and evacuation can be included. Because it is a cumulative curve, the curve always drops away with increasing N. Normally the F/N curve has a lower frequency cut-off at one in a billion (1×10^{-9}/yr). Regulators often split the graph into different regions, so that different actions have to be undertaken depending on where the F/N curve falls. Sometimes a maximum limit is placed on N (number of fatalities) possible for any event. This type of curve is normal for plant type hazardous installations where a large group of people could be affected and their location is well established (housing estates, schools etc) relative to the event location (the plant).

7.5.3 Risk Acceptance Criteria

The level of risk in the present study is quantified and compared against typical acceptable risks. The acceptable risk levels can change with time and place. Although there are differences between the legislation adopted in the various countries, there appears to be

broad consensus on the tolerability of risk. The majority of the countries would accept risk levels for the public around 10^{-5}/yr whilst the more stringent countries would set the tolerability level at 10^{-6}/yr. Detailed guidelines available from various countries have been presented below.

United Kingdom

In the UK the "Control of Major Accident Hazards" (COMAH) regulations are in line with the latest EU "Seveso-2" Directive. The regulations do not formally require a quantitative risk assessment, but the guidance notes make clear that in some circumstances quantification will help or could be asked for by the UK regulator - the Health and Safety Executive (HSE) - and this is often done in practice.

To advise planning authorities on developments around industrial installations, the UK HSE has been developing risk acceptance criteria over the years. As per HSE, UK (2001) guidelines, acceptable frequency level is less than 1×10^{-4} per year, the ALARP region lies in between 1×10^{-4} and 1×10^{-2} per year, while unacceptable frequency level is higher than 1 ×

10^{-2} per year. This acceptance criteria has been presented through F/N curve in **Fig. 7.2.**

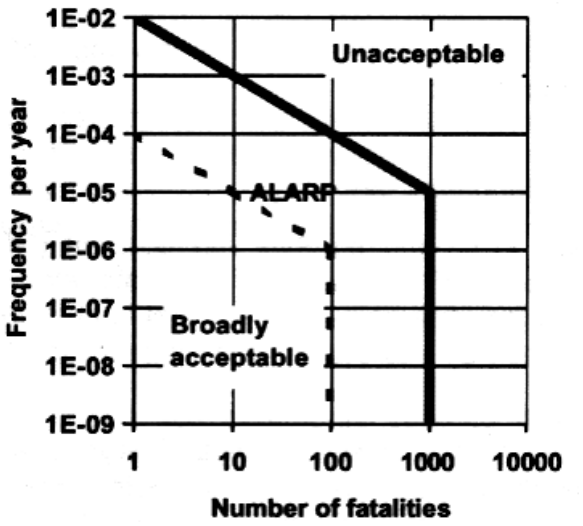

Fig. 7.2: HSE UK Risk Acceptance Criteria Guidelines

Canada: Major Industrial Accidents Council of Canada (MIACC)

The MIACC recommend individual risk levels for use in respect to hazardous substances risk from all sources, i.e. there is no need to distinguish between risk from a fixed facility at which hazardous substances may be found, or a pipeline or a transportation corridor. The acceptability levels are equally applicable. With these considerations in mind, the guidelines for acceptable levels of risk are presented in **Table 7.8**. The risk acceptance criteria for designated land zones have also been presented in **Fig. 7.3**.

Table 7.8 Land use and Industrial Risk according to MIACC

Location (based on Risk Level)	Possible Land Uses
From risk source to 1 in 10,000 (10^{-4}) risk contour:	No other land uses except the source facility, pipeline or corridor
1 in 10,000 to 1 in 100,000 (10^{-4} to 10^{-5}) risk contours:	uses involving continuous access and the presence of limited numbers of people bút easy evacuation, e.g. open space (parks, golf courses, conservation areas, trails, excluding recreation facilities such ás arenas), warehouses, manufacturing plants
1 in100,000 to 1 in 1,000,000 (10^{-5} to 10^{-6}) risk contours	Uses involving continuous access but easy evacuation, e.g., commercial uses, low-densily residential areas, offices
Beyond the 1 in 1,000,000 (10^{-6}) risk contour	All other land uses without restriction including institutional uses, high-density residential areas, etc.

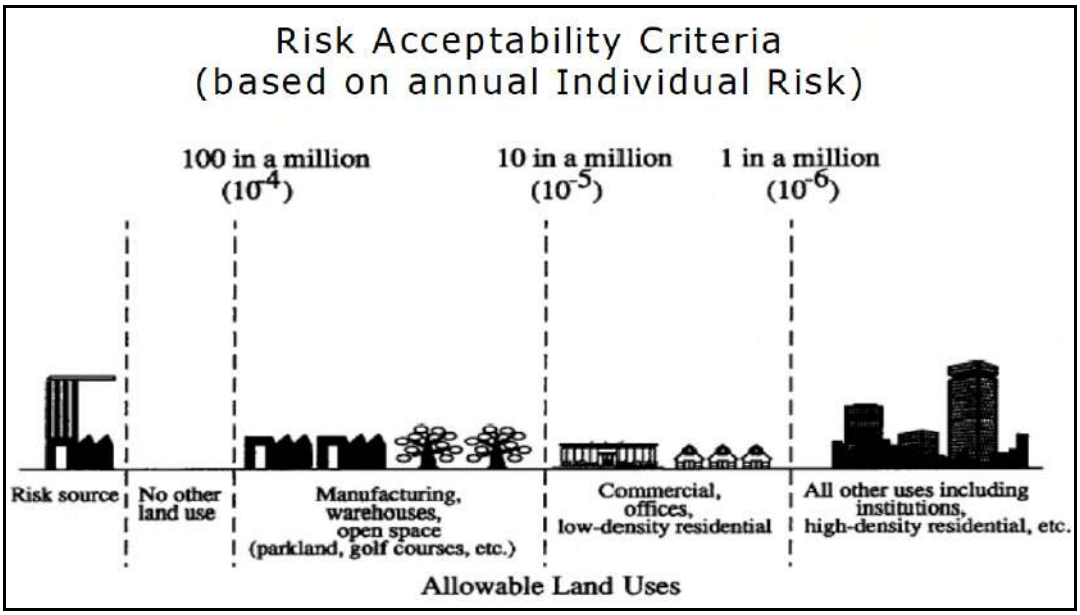

Fig. 7.3: Commonly Acceptable Individual Risks in Different Designated Land Zones

Malaysia

The criteria used by the Department of Environment (DOE) of Malaysia Government for existing facilities are outlined below for residential and industrial areas:

- Residential 1×10^{-6} fatalities / person / year
- Industrial 1×10^{-5} fatalities / person / year

It can be stated from the criteria that the risk of death to persons in a residential area must not exceed 1 chance in a million per person per year and the risk of death to persons in a nearby industrial area must not exceed 1 chance in 100,000 per person per year. If the quantified individual risk compares favourably with the acceptability criteria, then it is deemed acceptable. If not, the components of the overall risk are re-examined to determine where risk mitigation measures can be implemented cost effectively. Risk evaluation must also be conducted taking into account the fact that hazard analysis and consequence assessment only gives an estimation of risks from a facility.

Australia

The Western Australia (WA) Department of Planning has adopted risk criteria for hazardous installations. They are based on risk contours and can be summarised as follows:

- A risk level in residential zones of one in a million per year (1 x 10^{-6}/yr) or less, is so small as to be acceptable to the WA EPA (Environmental Protection Agency);
- A risk level in "sensitive developments", such as hospitals, schools, child care facilities and aged care housing developments, of between one half and one in a million per year (5 x 10^{-7} and 1 x 10^{-6}/yr) is so small as to be acceptable to the WAEPA;
- Risk levels from industrial facilities should not exceed a target of fifty in a million per year (1 in 20,000) at the site boundary for each individual industry, and the cumulative risk level imposed upon an industry should not exceed a target of one hundred in a million per year (1 in 10,000);
- A risk for any non-industrial activity, located in buffer zones between industrial and residential zones, of ten in a million per year or lower is so small as to be acceptable to the WA EPA;
- A risk level for commercial developments, including offices, retail centres and showrooms located in buffer zones between industrial facilities and residential zones, of five in a million per year or less, is so small as to be acceptable to the WA EPA.

The Netherlands

The policy statement approved by the Dutch Parliament states the following criteria for existing facilities. The risk is unacceptable if the 10^{-6}/yr risk contours affect residential areas or the F/N curve is above 10 fatalities with a frequency of 10^{-5}/yr with a slope of -2. This is illustrated in **Fig. 7.4**.

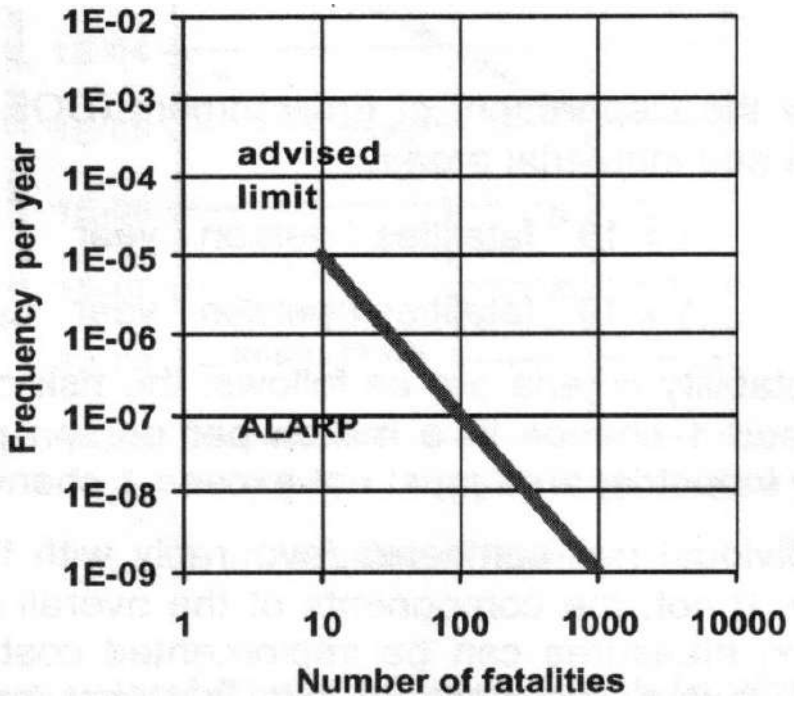

Fig. 7.4: Netherlands Societal Risk Guidelines (risk to public only)

Below the criteria, the ALARP, "As Low As Reasonably Practicable", principle should be used. For the Societal Risk it should be emphasised that the exposure or "presence" factor of population used for calculating the F/N curve during the day is 0.7 and while it is 1 during night. Also the assumption is made that being indoors gives protection where the fraction of people being indoors is 0.93 during daytime and 0.99 during night time.

Hong Kong Government Criteria

The Hong Kong government has published "Interim Risk Guidelines for Potential Hazardous Installations". The guideline covers new installations and expansion of existing installations and also controls the development of land around installations. It should be pointed out that although these are described as "guidelines" they are very strictly applied in practice. They are seen as necessary because of the special circumstances of Hong Kong, where there is a dense population in close proximity to industrial facilities, and are mainly used for land-use planning decisions. Societal risk guidelines are shown in **Figure 7.5** and set forth two criteria;

- A risk contour of 10^{-5}/yr for fatality as an upper limit of tolerability.

- The maximum F/N curve exceeds the line through the point of 10 fatalities at a frequency of 10^{-4}/yr with a slope of -1. No event at any frequency should take place which causes more than 1000 deaths.

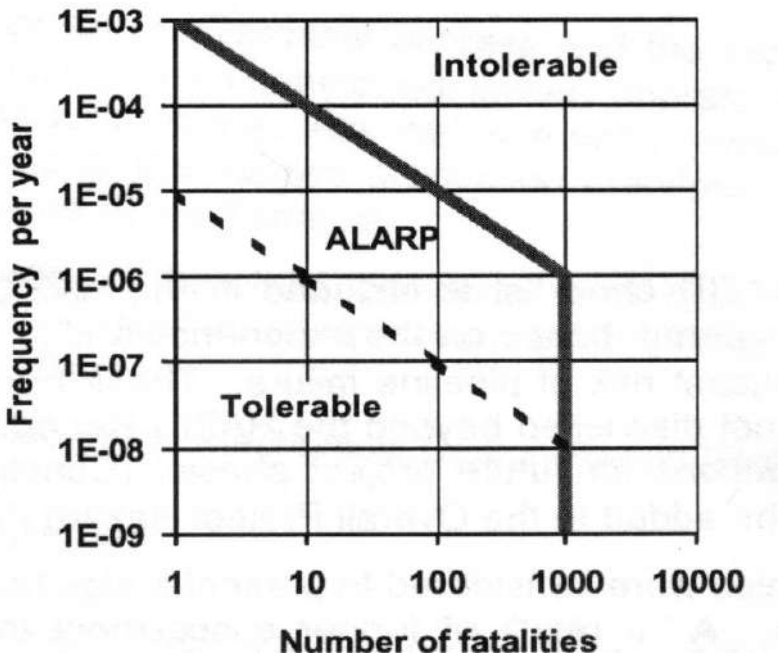

Fig. 7.5: Hong Kong Societal Risk Guidelines (risk to public only)

The Hong Kong regulators scrutinise each risk assessment closely and insist on the use of consistent methodology from case to case.

7.5.4 Risk Evaluation

The failure probability data for process equipment and storage tanks have been taken from international databases like IAOGP (International Association of Oil and Gas Producers) and HSE UK. The failure probabilities for all process equipment for 50 mm leak and catastrophic rupture scenarios have been taken as 3.5×10^{-4} and 1×10^{-5} respectively. Similarly, The probability values for storage tanks are 1×10^{-4} and 1×10^{-5}.

Individual risk and societal risk are computed using software **SAFETI MICRO 6.51** for process equipment, storage tanks, pipeline and pump. The individual risk is presented as contours of different risk levels on plot plan whereas societal risk is presented as F/ N curve clearing dividing the region into acceptable, ALARP and unacceptable levels. The failure probabilities of process equipment have been taken from IAOGP (International Association of Oil and Gas Producers) 2010 guidelines. The individual and societal risk has been

evaluated as per HSE UK guidelines. The evaluated risk for different process equipment for the proposed ADP-1 project has been presented below:

Main Fractionator

The individual risk levels for main fractionator of FCCU for the leak size of 50 mm and catastrophic rupture have been evaluated. For both the accidental releases, the maximum individual risk level of 10^{-6} and 10^{-5} per year have been observed, within the plant boundary limits, respectively. As per HSE UK guidelines, both the individual risk levels fall in acceptable region.

The societal risk for main fractionator of FCCU for the leak size of 50 mm and catastrophic rupture have not been developed. This indicates that there is no societal risk from this equipment.

Propylene Storage

The individual risk levels for propylene storage of for catastrophic rupture have been evaluated. The individual risk levels of 10^{-4} to 10^{-7} per year have been observed which are within plant boundary limits. As per HSE UK guidelines, the maximum individual risk level of 10^{-4} per year falls in ALARP which can be controlled by implementing mitigation measures as recommended in **Section 7.6**. The individual risk for 50 mm leak scenario has not been generated indicating no risk to the surrounding population due to this scenario.

The societal risk presented as F/N curves for propylene storage of for catastrophic rupture scenario has been shown in **Fig. 7.6**. As per HSE UK guidelines, the societal risk curve falls in broadly acceptable region. The societal risk for 50 mm leak scenario has not been generated indicating no risk to the surrounding population due to this scenario.

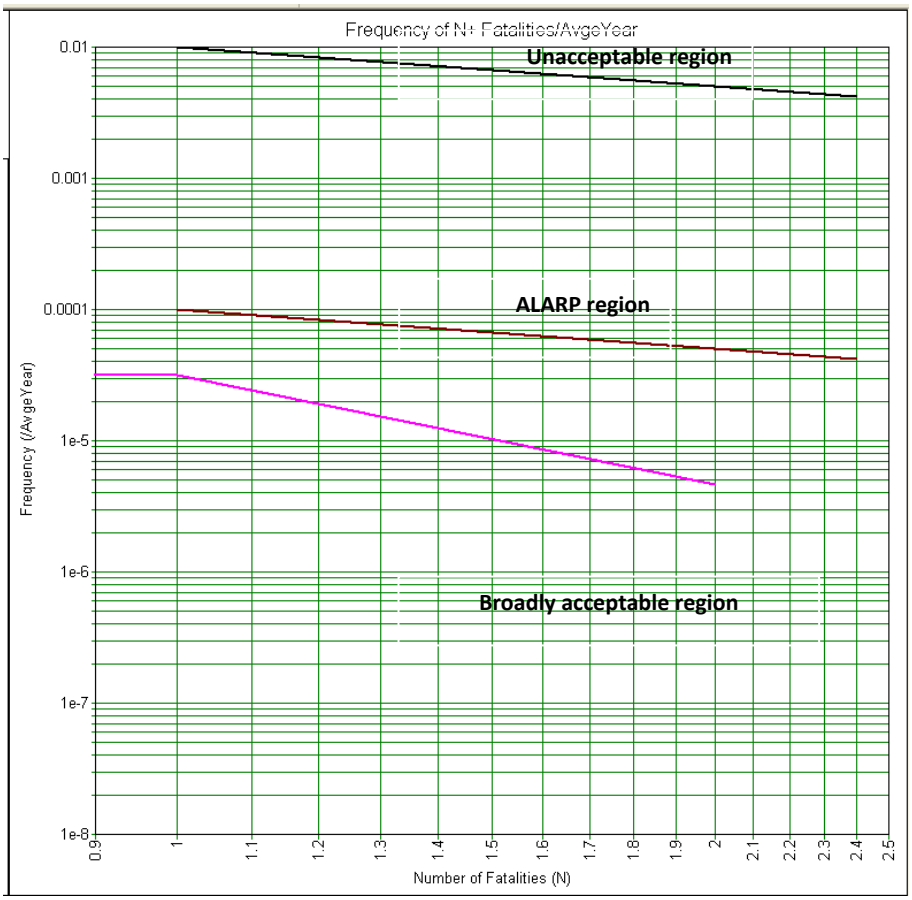

Figure 7.6 Societal Risk for Propylene Storage - Catastrophic Rupture

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6. Guidelines for quantitative risk assessment – CPR 18E ‘Purple Book’

7.6 Risk Mitigation Measures

The risk mitigation measures to minimize occurrence of hazardous event for the proposed ADP-1 project have been incorporated in this section. Specific recommendations for particular facility as well as general recommendation are detailed below

7.6.1 Specific Recommendations

Following are specific recommendations based on the outcome of MCA analysis:

7.6.1.1 Flammable Oil Storages

Following are mitigation measures for the storage of flammable materials

- Shut off and isolation valves should be easily approachable in emergencies
- Escape routes should be provided at strategic locations and should be easily accessible
- Necked flame, welding, hot surfaces or any other ignition source should not be permitted in storage area. Welding required for maintenance could be allowed with proper care regulated through a well-established Permit System as per OISD
- Gas and hydrocarbon detector should be provided in storage area to detect leakage
- The fire proofing material/coating resistant to weather effects such as chalking and erosion having adequate adhesion, strength and durability should be applied, whenever required
- The separation /space between the storage tanks in the storage areas should be according to the OISD guidelines and sufficient to escape in case of any emergency
- The inspection and checking of fire fighting facilities should be done periodically as per OISD
- Storage facility should be provided with water spray cooling system and foam pourer system, as per OISD requirement
- A wind direction pointer should be installed at storage site, so that in an emergency the wind direction can be directly seen and downwind population cautioned
- Signboards including phone numbers, no smoking signs and type of emergencies should be increased to cover all the locations of the plant

7.6.1.2 Pipeline

- All process piping should be complied with ASME B31.3 guidelines.
- Inspection of piping should be carried out at regular interval to assess the corrosion / erosion in the pipelines.
- Pressure/flow indication, hydrocarbon/smoke/toxic gas detectors should be available for early detection of any leakage and quick response.
- Overhead power lines should not be allowed to cross directly over the process piping.

- Gasket used in piping should have sufficient strength to resist crushing under the applied load and defy rupture under pressure. Gaskets should be chemically resist to fluid under all temperatures and pressures conditions.
- Selection of the valve type for process piping should be based on service experience. For example - Ball, Globe, Poppet vales should be used for high pressure and temperature pipelines.
- Proper lubricant should be used for threads of bolts and nuts during maintenance. Low or no chloride content lubricants should be used.
- Leakage detected in welded joints shall be repaired by draining, repair welding and non-destructively examining the joints in accordance with original requirements, and re-tested to the original test pressure.

7.6.1.3 Control Room

Following are the facilities to be provided at the control room to tackle the emergency scenarios:

- Fire Detection System should be installed in the control room
- VHF base station with a range of **25 km and VHF handsets of range 5 km** should be installed for ready communication in emergency
- Public address System should be installed to ease the communication to various corners of the plant
- The duties and responsibilities of different co-ordinators of Onsite Disaster Management Plan should be displayed in the Emergency Control Room.

7.6.2 General Recommendations

Following are general recommendations to be followed:

- Surrounding population (includes all strata of society) should be made aware of the safety precautions to be taken in the event of any mishap within the plant. This can effectively be done by conducting the safety training programs
- Buildings possibly subjected to external blast waves should be made of reinforced concrete. The windows should be made of blast resistant glass with strong frame as per OISD requirement
- Air intakes should not be placed at grounds level, to prevent combustible dense gas from entering into building
- Buildings possibly subjected to internal explosion should have a strong frame structure supporting roof and intermediate floors. The walls should be open. If a solid wall is needed, use low weight wall panels to facilitate early explosion venting

- Safety escape routes should be provided at strategic locations and should be easily accessible
- Grating and vent panels should be provided to minimize domino effects
- Critical switches and alarm should be always kept in line, bypassing if necessary for maintenance / operation requirement should be for limited time with proper approval and system in place
- Fire extinguishers should be tested periodically and should be always kept in operational mode
- Fire detectors should be installed near those units which handle large amount of explosive material and operate under high temperature and pressure
- Periodical mock drills should be conducted so as to check the alertness and efficiency of the DMP and EPP and records should be maintained
- Proper training should be given to staff to handle any emergency situation
- Signboard including phone numbers, no smoking signs and type of emergencies should be installed at various locations

7.6.2.1 Fire Protection Systems

The typical firefighting system for the various facilities described under this project is outlined. The exact details of the firefighting systems and capabilities to be installed and developed should be finalised after the completion of detailed engineering in consultation with the concerned process and equipment vendors. It is also to be understood that not all facilities described below will be applicable for every installation. The outline of the fire system proposed is described below.

Fire protection system shall be deigned in accordance with the requirements of OISD, Tariff Advisory Committee (TAC) of India, NFPA standards, design requirements and safe engineering practices and will have full capability for early detection and suppression of fire. The system will primarily consist of:

- Hydrant system
- Foam protection system
- Deluge sprinkler system
- Portable fire extinguisher
- Fire detection and alarm system

Hydrant System

The system should essentially consists of firewater storage, pumping, system pressurisation and all inter connected pipe work and auxiliary firefighting appliances. The

water storage and pumping capacity and other features of this system should be finalised after considering OISD requirements.

Adequate number of diesel engine driven / electric motor driven fire water pumps should be provided. The pumps should automatically start in the event of drop in header pressure. The actuation should be through pressure switches, the setting of which should be staggered to achieve sequential starting of the pumps to meet the system demand. When power supply is available, the electric motor driven pump should start first and in case of further pressure drop the engine driven pump should start. However when electric power is not available, the engine driven pump should cut-in depending on the system demand. The pumping capacity would meet the simultaneous water demand for foam protection of one oil tank, and supplementary foam hose stream in the oil dyke area, which is the maximum water demand in a single occurrence of fire. The pumping capacity should also meet the OISD guidelines for this size of plant, considering ordinary hazard occupancy.

The fire water system should be kept pressurised by the hydro-pneumatic tank, which takes care of small leakages from the fire water system. A jockey pump, sized as per OISD guidelines should, automatically replenish the water level in the hydro-pneumatic tank at periodic intervals. Air required for pressurising the hydro-pneumatic tank should be supplied by an electric motor driven compressor.

The outdoor hydrant system should be provided all over the plant for exterior protection. The hydrant mains should be laid underground. Hose houses, complete with all accessories, should be provided at suitable intervals. The overall plant should be divided in several fire zones, where the fire fighting action can be pursued effectively. The pressurised main should also be connected to Sprinkler/ emulsifier System for protection of transformers and Fuel Oil storage tanks.

Sprinkler System:

Automatic deluge sprinkler system should be provided for the protection of power transformer. An array of spray nozzles should be provided all around the protected area. The nozzles should be connected to the automatic deluge valve. A set of heat or smoke detectors, located in the area should sense the fire. Deluge valve should automatically open once two independent detectors sense fire.

Manually initiated water spray system should be provided for exposure protection of oil storage tanks, so that when one tank is on fire, the other tank can be cooled to guard against exposure heating. Pressurized water supply to all sprinkler systems should be tapped from the outdoor hydrant main.

Portable Fire Extinguisher:

Besides, fire hydrant arrangement, portable fire extinguishers of suitable categories should be placed at control rooms, electrical switchgear room and various utility

buildings for immediate use in the event of fire. Three different kinds of extinguishers i.e. foam, CO_2 and multipurpose dry chemical (MPDC) should be provided. Each type of extinguisher has its own characteristic to fight a particular class of fire. The size and type of extinguishers should be decided as per recommendations of NFPA and should be placed in convenient accessible locations.

7.6.2.2 Electricity Hazard

- All electrical equipment shall be provided with proper earthing. Earthed electrode shall periodically tested and maintained
- Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant, ready identification of firefighting facilities such as fire water pumps and fire alarm stations
- All electrical equipment shall be free from carbon dust, chemical deposits, and grease
- Use of approved insulated tools, rubber mats, shockproof gloves and boots, tester, fuse tongs, discharge rod, safety belt, hand lamp, wooden or insulated ladder and not wearing metal ring and chain
- Flame and shock detectors and central fire annunciation system for fire safety should be provided
- Temperature sensitive alarm and protective relays to make alert and disconnect equipment before overheating
- Danger from excess current due to overload or short circuit should be prevented by providing fuses, circuit breakers and thermal protection
- Carbon dioxide, halon or dry chemical fire extinguishers are to be used to extinguish electrical fires

7.6.2.3 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems. The PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. The **Table 7.9** presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

- Active use of PPE if alternative technologies, work plans or procedures cannot eliminate or sufficiently reduce a hazard or exposure
- Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual

- Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees
- Selection of PPE should be based on the type of hazards to be handled

Table 7.9: Details of Personal Protective Equipment

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapours, light radiation	Safety glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords	Plastic helmets with top and side impact protection
Hearing protection	Noise, ultra-sound	Hearing protectors (ear plugs or ear muffs)
Foot protection	Failing or rolling objects, points objects. Corrosive or hot liquids	Safety shoes and boots for protection against moving and failing objects, liquids and chemicals
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures	Gloves made of rubber or synthetic material (Neoprene), leather, steel, insulation materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapours	Facemasks with appropriate filters for dust removal and air purification (chemical, mists, vapours and gases). Single or multi-gas personal monitors, if available
	Oxygen deficiency	Portable or supplied air (fixed lines). Onsite rescue equipment
Body / leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration	Insulating clothing, body suits, aprons etc. of appropriate materials

7.6.2.4 Occupational Health Hazards

Following are measures to tackle occupational health hazards:

- Detect the possible onset of an occupational disease
- Monitor personal exposure with the help of biological monitoring
- Check the effectiveness of preventive and control measures on regular basis
- Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances
- Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking
- Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards
- Periodic medical hearing checks should be performed on workers exposed to high noise levels
- Preventing spread of communicable diseases through food handlers
- Provisions should be made to provide orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees
- Contractors that have the technical capability to manage the occupational health and safety issues of their employees should be hired, extending the application of the hazard management activities through formal procurement agreements
- **Two ambulances and full fledge first aid treatment facilities should be available at all times.**

7.6.2.5 Falling Objects

- Provide safety helmets to protect workers below against falling objects
- Barriers like a toe boards or mesh guards should be provided to prevent items from slipping or being knocked off the edge of a structure
- Secure objects to the structure like lashing of scaffold boards
- Ensure that there are no loose objects and all tools are properly secured
- Create an exclusion zone beneath areas where work is taking place
- Danger areas should be clearly marked with suitable safety signs indicating that access is restricted to essential personnel wearing hard hats while the work is in progress.

7.6.2.6 Oil Spill Response Plan

Spills of oil to land require immediate response action to stop the source of the discharge and to limit the spread of material. Immediate response actions and notification procedures shall be developed. Attention must be paid to fire and safety hazards. For terrestrial areas, selection of appropriate control and containment techniques is dependent on the:

- Nature of the substrate,
- Slope of the terrain,
- Amount of product, and
- Time available to implement the response action.

The quantity and time parameters reflect the reality of constructing a barrier of appropriate size in the time available. These factors can only be judged in the field at the time of the incident. Should it be impossible to implement the desired method at a desired location due to a lack of time or access, a new control point would be selected further down the slope. If containment is still impossible and human safety is in question, the threatened area would need to be evacuated.

7.7 Approaches to Disaster Management Plan (DMP)

Disaster is an undesirable occurrence of events of very high magnitude that adversely affects activities. In spite of various preventive and precautionary measures taken in works, the possibility of a mishap cannot be totally ruled out. An emergency could be the result of malfunction or non-observance of operating instructions. It could, at times, be the consequences of acts outside the control of residents / employees like severe storm, earthquake, flooding, or deliberate acts of arson or sabotage. Hence, the need to prepare emergency plan for dealing with the incidences, which may still occur and are likely to affect life and property in and around the proposed expansion, has been identified in this plan.

The DMP is prepared to meet any grave emergency which can occur due to natural disasters such as floods, earthquakes, tsunami, cyclone and heat wave. Man-made disasters such as acts of war (terrorism), fire and explosion have also been considered. This study has focused on the possible hazards confined within the premises and the corresponding action plan. The DMP presents a clear organizational structure and lists responsibilities and actions expected from the Government departments during an emergency.

7.7.1 Objectives of DMP

The purpose of DMP is to give an approach to detail organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies associated to production and operations in the site. The overall objectives of DMP are to:

- Identify natural and human induced hazards and provide guidance towards rapid and timely disaster prevention, preparedness, response and recovery.
- Ensure safety of people, protect the environment and safeguard commercial considerations
- Immediate response to emergency scene with effective communication network and organized procedures
- Obtain early warning of emergency conditions so as to prevent impact on personnel, assets and environment
- Safeguard personnel to prevent injuries or loss of life and evacuate them from a facility when necessary
- Provide a framework of coordinated arrangements for the emergency management operational procedures in the event of disaster or emergency

7.7.2 Causes of Disaster

Various causes that can lead to the above-referred disaster are as follows:

(a) In-plant emergencies due to deficiencies in system / malfunctioning / improper handling in:

- Operations
- Maintenance
- Equipment failure
- Design

(b) Natural calamities like

- Cyclone/Storm/Gale/Flood
- Lightning
- Earthquake

(c) Deliberate acts of man like

- Sabotage
- Riot
- War

(d) Projectile hitting the facility

7.7.3 Different Phases of Disaster

Following are different phases of disaster:

Warning Phase:

Many disasters are preceded by some sort of warning. For example, with the aid of satellites and network of weather stations, many meteorological disasters like cyclones, hurricanes, heavy rains and floods can be predicted and preventive actions can be taken to eliminate / reduce their effect.

Period of Impact Phase:

This is the period when the disaster actually strikes and very little can be done to reduce the effects of disaster. The period of impact may last for a few seconds (like fire, dust explosion, gas leak) or may prolong for days. This is the time to bring the action plan in force. The coordinators in organization structure will perform the responsibilities assigned to them. Needless to emphasize that prompt and well organised rescue operations can save valuable lives.

Rescue Phase:

The rescue phase starts immediately after the impact and continues until necessary measures are taken to rush help and combat with the situation.

Relief Phase

In this phase, apart from organization and relief measures internally, depending on severity of the disaster, external help should also be summoned to provide relief measures like evacuations to a safe place and providing medical help, food, shelter clothing etc. This phase will continue till normalcy is restored.

Rehabilitation Phase:

This is the final and the longest phase. It includes rebuilding damaged property, estimating the damages, payment of compensation, etc. Help from revenue/insurance authorities need to be obtained to assess the damage, quantum of compensation to be paid etc.

7.7.4 Key Elements of DMP

Following are the key elements of Disaster Management Plan:

- Basis of the plan
- Accident/emergency response planning procedures
- On-site Disaster Management Plan
- Off-site Disaster Management Plan

7.7.4.1 Basis of the Plan

Identification and assessment of hazards is crucial for on-site emergency planning and it is therefore necessary to identify what emergencies could arise in production of various products and their storages. Hazard analysis or consequence analysis gives the following results

- Hazards from spread of fire or release of flammable and toxic chemicals from process and storage units

- Hazards due to formation of pressure waves due to vapor cloud explosion of flammable gases and oil spill hazards

7.7.4.2 Emergency Planning and Response Procedures

Emergency rarely occurs; therefore activities during emergencies require coordination of higher order than for planned activities carried out according to fixed time schedule or on a routine day-to-day basis. To effectively coordinate emergency response activities, an organizational approach to planning is required. The important areas of emergency planning are organization and responsibilities, procedures, communication, transport, resource requirements and control centre. The offsite emergency requires additional planning over and above those considered under onsite plans, which should be properly integrated to ensure better coordination.

The emergency planning includes anticipatory action for emergency, maintenance and streamlining of emergency preparedness and ability for sudden mobilization of all forces to meet any calamity.

7.7.4.3 On-site Disaster Management Plan

Onsite disaster is an unpleasant event of a magnitude which may cause extensive damage to life and property due to plant emergencies resulting from deficiencies in operation, maintenance, design and human error, natural calamities like flood, cyclone and earthquake; and deliberate and other acts of man like sabotage and riot. The purpose for the on-site disaster management plan is:

- To protect persons and property of processing equipment in case of all kinds of emergencies
- To inform in-plant and surrounding people about emergency if it is likely to adversely affect them
- To inform project site authorities and helping agencies like doctors, hospitals, fire, police transport in advance and also at the time of actual happening
- To identify, assess, foresee and work out various kinds of possible hazards, their places, potential and damaging capacity. It can be possible to review, revise, redesign, replace or reconstruct the process, plant vessels and control measures, if so assessed.

In order to handle emergency situations, an organizational chart showing the involvement of key personnel of the project site and coordination among them are shown in **Fig. 7.7**.

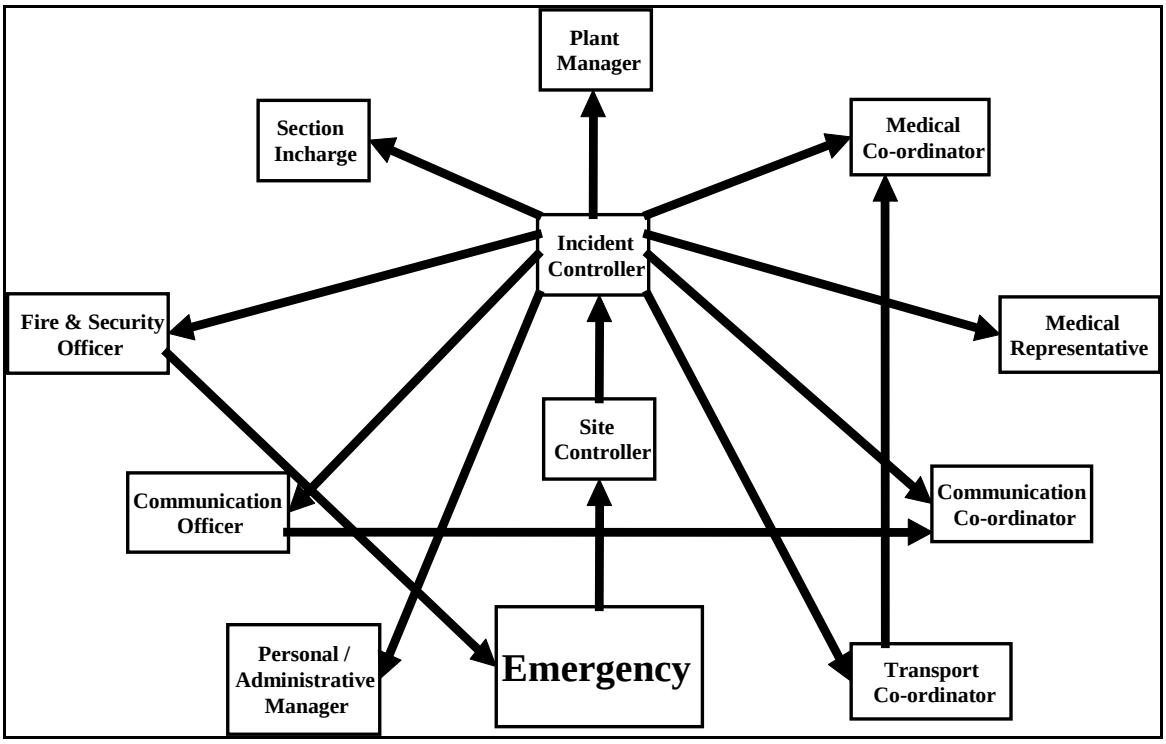

Fig. 7.7 Onsite DMP - Disaster Control / Management System

Emergency Organization Structure

Following are the key personnel of the plant which are responsible to take appropriate actions during emergencies.

Site Main Controller

President/SSM - (the senior most functionary available at site).

The President/Site Shift Manager (SSM) will be designated as the Site Main Controller at the time of an emergency and report at the Emergency Control Centre (ECC) which will be the Primary Command Post. He will be the Chief Co-ordinator and take overall command of the emergency management. He will be assisted by other co-ordinators as designated for various functions. The Site Main Controller will provide all decisions support and resources support to the Site Incident Controller at the incident site for initiating appropriate actions for emergency control. He will also liaise with mutual aid members and all outside agencies including Local Crisis Management Committee, District Contingency Plan Committee (District Collector), Police, Civil Defence, Factories Inspectorate, etc. to seek assistance/help and provide necessary information to them.

Normally, the SSM is available on round the clock duty at the site to co-ordinate overall manufacturing activities and management of emergency. In the event of an

emergency, the Site Shift Manager (SSM) will assume the charge of the Site Main Controller till the Executive or the President arrives.

Site Incident Controller

AVP/GM/DGM/Sr. Mgr./Mgr. - The next lower to senior most functionary of operation available at site will be Site Incident Controller. On receiving information about the emergency, he will report at the incident site and take over from the Deputy Incident Controller (shift-in-charge). He will take overall command of the emergency control operation as the Site Incident Controller and will take decisions in co-ordinations with Site Main Controller for controlling emergency situation. He will co-ordinate with all the key personnel, firefighting and rescue team leaders and other support services and provide necessary information and advice to them for effectively managing control measures / actions.

Deputy Incident Controller

The shift-in-charge is available on round the clock duty in every plant. He is competent for plant operation and responsible for all activities related to production / maintenance including prevention / control of incidents and handling emergencies (if any) in the plant. He will be designated as the Deputy Incident Controller. In the event of an emergency in the plant, he will immediately assume the charge of the Site Incident Controller and take decisions in consultation with the Site Main Controller. He will initiate immediate actions for controlling/mitigating emergency situation at the incident site till the Site Incident Controller arrives.

Coordinators

The senior most functionaries available at site in the respective services will be the co-ordinators at the time of an emergency. They will report at the Emergency Control Centre (ECC), known as the Primary Command Post, unless and otherwise instructed by the Site Main Controller. They will assist and advise the Site Main Controller in all matters for effectively managing control measures and mitigating operations.

Emergency Control Centre (The Primary Command Post)

In the event of an emergency, SSM Office or any other designated office in the same building will be designated as the Emergency Control Centre, which will be known as the Primary command Post. If, the SSM office is likely to be affected due to unfavourable wind direction or any other reasons, the Emergency Control Centre will be shifted to a room which will be having necessary facilities to connect communication links as provided in the SSM Office.

Role and Responsibilities of Key Personnel

Roles and responsibilities of various key personnel are outlined below

Site Main Controller

The Site Main Controller will be the chief co-ordinator and shall be assisted by other co-ordinators (senior most functionaries in the respective divisions). He will take overall command of the emergency management and his duties and the responsibilities are

- Report at the Emergency Control Centre as soon as he gets information about the emergency at site and will assume overall responsibility of taking decisions and directing actions as necessary for mitigating the situation and managing the emergency effectively with due consideration and priorities for personnel safety, safety to the plant's property and the environment
- Assess the magnitude of the situation in co-ordination with the Site Incident Controller / Dy. Incident Controller and decide whether major emergency exists or is likely to develop, requiring external assistance. Accordingly, he will decide to inform local/district emergency chief and other emergency control groups for help and the nature of help required including assistance from mutual aid members and declare on-site emergency
- Decide the safe route of entry for external assistance/help to reach at site of the incident considering wind direction and the place of the incident and also the place of reporting such assistance. He will also direct the security to guide them properly
- Ensure that the key personnel and co-ordinators are called in
- Ensure that all non-essential workers, visitors, contractors are safely moved to assembly points and direct for search and rescue operation within the affected areas, if necessary
- Be in constant communication with the Site Incident Controller to continuously review and assess the situation and possible developments
- Direct actions for safe shut down of plant(s) or section of the plant and evacuation of plant personnel and other necessary action is in consultation with the other co-ordinators
- Exercise direct operational control over areas in the complex other than those affected in consultation with other co-ordinators
- To liaise with the local meteorological office to receive early notification of changes in wind direction and weather conditions
- Liaise with the senior officials of police, fire brigade, medical and factory inspectorate and pass on information on possible effects to the surrounding areas outside the factory premises and necessity of evacuating the area and moving the people to safe places
- Liaise with various co-ordinators to ensure that various teams are functioning well, casualties are receiving attention and traffic movement within the works is well regulated

- Arrange for a log of the emergency to be maintained in the Primary Command Post
- Release authorized information to press through the media co-ordinator

Site Incident Controller

The Site Incident Controller is the key personnel for operations function reporting at the incident site and will take the overall command of actions for emergency control operation on his arrival at the incident site. He will be supported by other key personnel representing various emergency services and initiate emergency control actions under the direction of the Site Main Controller (Primary Command Post). The duties and the responsibilities of the Site Incident Controller include the following:

- Report at the incident site immediately after getting information about an emergency. Upon his arrival at the site, he will assess the scale of emergency in consultation with the Deputy Incident Controller and evaluate, if a major emergency exists or is likely to develop and inform Emergency Control Centre Primary Command Post) accordingly asking for assistance and indicating kind of support needed
- Take overall control of handling the emergency at site and take action for isolation of source of containment loss to the extent feasible. Simultaneously, in case of fire organize appropriate fire response in co-ordination with key personnel (fire & safety) to get the situation under control and to prevent it's escalation
- Set up effective communication pathway and establish contact with Site Main Controller and keep him informed about the development
- Keep on assessing the emergency situation at the site and communicate to the Site Main Controller and keep him informed about the development
- Co-ordinate the activities of other key personnel reporting at the Field Command Post, under his overall command
- Direct all operation with the affected areas giving due priorities for safety of personnel and to minimize damage to environment, plant and property
- Provide advice and information to fire fighting and rescue personnel, external fire services and other emergency services/teams as and when they arrive at the incident site and co-ordinate with them for effective control actions
- Ensure that all non-essential workers and staff within the affected area are evacuated to appropriate assembly points and that areas are searched for casualties
- Organize rescue teams for search of casualties in the affected areas (if any) and send them to safe areas / medical centre for first aid and medical relief

- Seek additional support and resources as may be needed through Primary Command Post
- Send decision support from the Primary Command Post for decision such as precautionary shut down of neighbouring facilities, precautionary evacuation of people in the neighbouring facilities, activating mutual aid plan, etc.
- Be in constant liaison with the Site Main Controller and keep him informed about the situation at the incident site
- Preserve all evidences so as to facilitate any inquiry into the cause and circumstances, which caused or escalated the emergency (to arrange photographs, video, etc.)
- Arrange for head count after the emergency is over with respect to the personnel on duty in the affected areas

Deputy Incident Controller

Normally, the Shift-in-charge of a plant being always available at the plant site and well aware of the plant operating conditions at all times will be designated as the Deputy Incident Controller and assume the charge of the Site Incident Controller at the time of an emergency till the Site Incident Controller arrives at the incident site. He will assist the Site Incident Controller on his arrival and work under his direction in emergency control operation. The responsibilities and duties of the Deputy Incident Controller will be as defined for the Site Incident Controller. In addition he will ensure the following:

- In the event of an emergency, caused due to any incident in the plant, he will immediately activate plant level emergency siren (hooter) to warn the field personnel, contractors' employees, etc. and also arrange for announcement about the emergency and necessary instruction for them for assembling at the safe assembly point or evacuation, etc.
- Ensure that the SSM and senior plant personnel have been informed about the emergency

Medical Coordinator

The Chief Medical Officer (or the next in command available at site) will be the Medical Co-ordinator and perform the following duties:

- He will contact the Site Main Controller immediately after receiving the information about the emergency
- He will report immediately at the Emergency Control Centre (Primary Command Post) or Occupational Health Centre (OHC) as instructed by the Site Main Controller and contact the Key personnel (Medical) and take stock of the situation

- He will assist and advise the Site Main Controller in all critical decisions in the area of health/medical services to the affected persons and keep constant liaisons with him
- Organize rescue and first aid arrangements for the affected persons at the site, as may be necessary with essential staff/equipment and post additional ambulance for transporting seriously injured persons
- Ensure that adequate paramedical staff, equipment and medicines are available at the OHC. He will mobilize additional resources from neighbouring industries, if necessary
- To liaise with the local medical authorities and city hospitals, if the causalities are more and situation demands treatment at additional medical centres
- To co-ordinate with the Transport Co-ordinator for transporting victims to various hospitals
- To arrange for additional ambulances from other hospitals/ Municipal Corporation
- The Medical Co-ordinator should ensure the upkeep of agreed medical supplies, antidotes and equipment that should always be kept in stock for treating victims of burns and hazardous chemicals. The medical authorities should be aware of the type of treatment to be administered
- He will liaise with the media co-ordinator for release of news to the press

Security Co-coordinator

The Chief of Security or the next in command available at site shall be the Security Co-ordinator. He will have the following duties / responsibilities:

- He will instruct and deploy plant security personnel to ensure that the law and order is maintained ; and unnecessary gathering of the personnel at the scene of emergency is prevented and ensure control of traffic movement in and out of the factory areas
- He will instruct the security personnel / Security Gates to direct and guide external emergency vehicles (Fire tenders/ambulances etc.) called for assistance/help from neighbouring industries/Local administration, to the scene of incident
- He will instruct security personnel who could be spared to assist Site Incident Controller/Key Personnel (fire and Safety) in fire fighting and evacuation of personnel, at the Incident Site
- He will take action to regulate traffic movement and prevention of traffic jams inside the works as well as outside the factory gates for proper and speedy movement of the emergency vehicles, ambulances, other vehicles carrying outside resources, etc.

- He will mobilize additional security force for help, as necessary
- He will liaise with the police and other local authorities for external help, as necessary for evacuation of the neighbouring areas outside the factory premises in consultation with the Site Main Controller
- If necessary, he will arrange for announcement through the mobile P.A. system for alerting and instructing the population in the surrounding areas as directed by the Site Main Controller

Engineering Coordinator

- He will report to the Site Main Controller at the Emergency Control Centre (Primary Command Post) immediately after receiving information about On-site emergency
- He will take stock of the situation and assist/advise the Site Main Controller in deciding control strategies
- He will mobilize the team from the Maintenance Dept. to assist the Site Incident Controller in control operation at the Field Command Post
- Arrange isolation of electrical lines from distribution point/substations as required by the Site Incident Controller by calling the Electrical Engineer / Electricians
- Provide all other engineering support, as may be required
- Liaise with Key Personnel (Eng./Maintenance) and co-ordinate with other groups

Communication Coordinator

Communication Co-ordinator plays very important part at the time of an emergency particularly when extensive disruption of services takes place. He has the following duties and responsibilities:

- To ensure all available communications links remain functional
- To quickly establish communication links between the Field command Post and (if this happens to be in remote off site area) and the Primary Command Post
- To arrange for announcement on the public address system and maintain contacts with congregation points like canteen, main gate, control rooms etc.
- To ensure that previously agreed inventory of various types of communication equipment is maintained in working condition and frequent checks are carried out and records maintained
- To maintain voice record of significant communications with timings received/passed from the Primary Command Post

- To provide additional/alternate communication facilities as required at the site

Transport Coordinator

The Transport Co-ordinator shall perform the following duties

- Mobilize all available company's vehicles for emergency use along with the drivers
- Arrange for transport of victims to hospitals/dispensaries
- Arrange for duty rotation of the drivers to meet the emergency situation
- To direct refuelling of the vehicles
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required
- To arrange for vehicles from outside local transport agencies, if required
- To keep in contact with the Site Main Controller for evacuation of personnel and transportation of victims

Media Coordinator

The Media Co-ordinator will co-ordinate the following under the direction of the Site Main Controller:

- He will liaise with various media and release written statements to the press through prior concurrence of the Chief Co-ordinate
- He will handle media interview with various media groups make arrangements for televising the information about the incident, the number of casualties, etc
- He will inform State and Central Government and the statutory bodies of the nature and magnitude of the incident, the number of casualties, etc.
- He will locate himself such that media persons/third parties do not need to go past the complex security gates and that adequate communication links exists
- Media personnel often insist on visiting incident scene. He will escort media team(s) If such visits are approved by the Chief Co-ordinator
- He will be in constant contact with the Medical Co-ordinator, and other co-ordinators to be aware of latest development and closely liaise with the Chief Co-ordinator

7.7.4.4 Off-site Disaster Management Plan

Emergency is a sudden unexpected event, which can cause serious damage to personnel life, property and environment outside the boundary wall of the project site as a

whole, which necessitate evolving off-site emergency plan to combat any such eventuality. In offsite disaster management plan, many agencies like revenue, public health, fire services, police, civil defence, home guards, medical services and other voluntary organization are involved. Thus, handling of such emergencies requires an organized multidisciplinary approach.

Evacuation of people, if required, can be done in orderly way. The different agencies involved in evacuation of people are civil administration (both state and central), non-Govt. organizations, factory inspectorate and police authorities.

Before Crisis

This will include the safety procedure to be followed during an emergency through posters, talks and mass media in different languages including local language. Leaflets containing do's/ don'ts before and during emergency should be circulated to educate the people in vicinity.

- People in vicinity of hazardous installation, and others who are potentially affected in the event of an accident, should be aware of the risks of accidents, know where to obtain information concerning the installation, and understand what to do in the event of an accident
- Non-governmental Organizations (NGOs) such as environmental, humanitarian and consumer group should motivate their constituents and others, to be involved in risk reduction and accident prevention efforts. They should help to identify specific concerns and priorities regarding risk reduction and prevention, preparedness and response activities
- NGOs should facilitate efforts to inform the public and should provide technical assistance to help the public analyze and understand information that is made available
- Public authorities and management team of hazardous installation should establish emergency planning activities/ programs for accidents involving the hazardous substance
- Emergency alert system should be in place to warn the potentially affected public in the surrounding area
- The system chosen should be effective and provide timely warning. Suitable warning system could include or a combination of for e.g.: sirens, automatic telephone message, and mobile public address system

During Crisis

- **Central Control Committee:** As the off-site plan is to be prepared by the Government authorities, a central control committee should be formed under the chairmanship of area head. Other officers from police, fire, factory, medical, engineering, social welfare, publicity, railway, transport and requisite

departments shall be incorporated as members. Some subject experts will also be included for guidance. The functions of committee should be:

- To work as main co-coordinating body constituted of necessary district heads and other authorities with overall command, coordination, guidance, supervision, policy and doing all necessary things to control disaster in shortest times
- To prepare, review, alter or cancel this plan and to keep it a complete document with all details
- To take advice and assistance from experts in fields to make plan more successful
- To set in motion all machineries to this plan in event of disaster causing or likely to cause severe damage to public, property or environment
- The incident control committee, traffic control committee and press publicity committee will first be informed as they play important role during initial hours of emergency

♦ **Medical Help, Ambulance and Hospital Committee:** This committee consisted of doctors for medical help to the injured persons because of disaster. Injuries may be of many types. As such doctors are rarely available we have to mobilize and utilize all available doctors in the area. Functions and duties of the committee include:

- To give medical help to all injured as early as possible
- Civil surgeon is the secretary who will organize his team
- On receiving information to rush to spot he will immediately inform his team and will proceed with all necessary equipment
- First aid and possible treatment shall be provided at the spot or at some convenient place and patients may be requested to shift to hospitals for further treatment
- All efforts shall be made on war basis to save maximum lives and to treat maximum injuries
- Continuity of the treatment shall be maintained till the disaster is controlled

♦ **Traffic Control, Law and Order Committee:** The committee is headed by District Superintendent of Police. Functions and duties of this committee should be:

- To control traffic towards and near disaster , to maintain law and order
- To evacuate the places badly affected or likely to be affected

- To shift the evacuated people to safe assembly points
- To rehabilitate them after disaster is over
- Necessary vehicles, wireless sets and instruments for quick communications shall be maintained and used as per need

After Crisis

- At the time of disaster, many people may badly be affected. Injured people shall be treated by medical help, ambulance and hospital committee, but those not injured but displaced kept at assembly points, whose relative or property is lost and houses collapsed shall be treated by the welfare and restoration committee. Functions and duties of the committee are:
  - To find out persons in need of human help owing to disastrous effect. They may give first aid if medical team is not available
  - They will serve the evacuated people kept at assembly points. They will arrange for their food, water, shelter, clothing, sanitation, and guidelines to reach any needful places
  - They will look for removal and disposal of dead bodies, for help of sick, weak, children and needy persons for their essential requirements
  - The team will also work for restoration of detached people, lost articles, essential commodities etc.
  - The team will also look after the restoration of government articles
  - The team will also ensure that the original activities, services and systems are resumed again as they were functioning before the disaster

Responsibilities of Various Government Departments

Local authorities and Government departments are important functionaries for expedition of DMP. The plant authorities are responsible in providing exact details of accidents to local authorities and Government departments. The actions and responsibilities expected from concerned departments are listed below:

Police Department

- Warning and advice in the affected area. Use mike fitted van. Get ready with the message to be announced
- Regulating and diverting traffic
- Maintaining law and order in the area
- Ensuring security of the belongings of the evacuees

- Co-ordination with the transport authorities
- Co-ordination with civil defense and home guards
- Co-ordination with army, navy, air force as required
- Co-ordinate with state fire services
- Arrange for post-mortem of dead bodies
- Establish communication center

Medical Department

- Set up temporary medical camp
- Ensuring medical facilities at the emergency site and neighbourhood areas
- Arranging for casualties to be sent to government /private hospitals
- Co-ordinate the activities of primary health centers and municipal dispensaries to ensure required quantities of drugs and equipment
- Securing assistance of medical and paramedical personnel from nearby hospitals/institutions
- Temporary mortuary and identification of dead bodies

General Administration Department

- Evacuation of personnel from the affected area
- Arrangements at rallying posts and parking yards
- Rehabilitation of evacuated persons
- Co-ordination with other agencies such as police, medical, animal husbandry, agriculture, electricity board, fire services, home guards - civil defense
- Nominate a press officer
- Establishing shelters for rescue, medical, firefighting personnel, etc.

Fire Services Department

- Assist in firefighting by mobilizing required number of fire engines
- Rendering assistance for fire fighting

Factory Inspectorate

The officer of factory inspectorate shall, within 72 hours of the closure of the incident, schedule a debriefing to all concerned agencies. This debriefing shall include, but not be limited to

- Analysis of the incident including type of scenario, type of fire, impact distance, casualties and injuries etc.

- Problem areas identified
- Revisions to the emergency plan, if needed
- Factors that caused the incident
- Upon completion of the debriefing, open discussion for questions and answers should be allowed

7.7.5 Natural Disasters

The emergency plan to tackle natural disasters like earthquake, flood, cyclone, tsunami and heavy rain has been detailed below:

Earthquake

An earthquake is the perceptible shaking of the surface of the earth resulting from the sudden release of energy in the earth's crust that creates seismic waves. It has significant impact on property as well as population. Hence, prompt actions in managing earthquake are important in minimizing its effect. All structures at plant site shall be designed with appropriate/internationally accepted safety margins. Following are measures to be taken in case of earthquake

- Facilitate selective strengthening and seismic retrofitting of proposed structures
- Strengthen the emergency response capability in earthquake-prone areas
- Keeping records of vulnerable areas, monitoring of rescue and relief operations deciding response, managing the data base etc.
- Introduce appropriate capacity development interventions for effective earthquake management through education training, research and development and documentation

Flood

Floods are the most common and widespread of all natural disasters. Following are measures to be taken in case of floods

- Focus resources on minimizing the spread of water into other areas of the plant
- Protect property and records by removing items from floors and /or covering with water resistant coverings.
- Attempt to move items of value to "higher ground" if possible.
- Evacuate personnel as needed. Utilize the fire alarm system if an immediate evacuation is required.

- Mitigation measures can be structural or non-structural. Structural measures use technological solutions, like flood levees. Non-structural measures include legislation, land-use planning (e.g. the designation of nonessential land like parks to be used as flood zones), and insurance.
- The response phase includes the mobilization of the necessary emergency services and first responders in the flood area. This is likely to include a first wave of core emergency services, such as fire-fighters, police and ambulance crews. They may be supported by a number of secondary emergency services, such as specialist rescue teams

Cyclones

Cyclones are considered as one of the most damaging natural disasters. Cyclone refers to any spinning storm that rotates around a low-pressure center. They make impact by killing people and damaging property. Following are measures to be taken in case of cyclones and severe storms:

- Land use management should provide protection from wind and storm surge
- Engineering of structures should withstand wind forces and water damage (including storm surge)
- Plant buildings should be constructed with higher wind-resistant capacity
- Securing of elements such as metal sheeting, roofing, and fences should be done to avoid severe damages
- Safety shelters are to be arranged to tackle cyclones and storms
- Cyclone and severe weather warning systems should be installed
- Community awareness regarding cyclone risk and evacuation plan should be properly addressed

Heavy Rain

Heavy rainfall can lead to flooding. It can also trigger landslides which can threaten human life, disrupt transport and communications, and cause damage to buildings and infrastructure. A number of landslides had occurred due to heavy rains causing loss to property and killing people. Hence the risk from heavy rains is high. Early warning system for the predication of heavy rains should be made available. The people should informed through SMS, loudspeaker etc. regarding the possibility of heavy rains. The necessary precautions to be taken during and after heavy rains should also be informed.

Heat Wave

In recent years, excessive heat has caused more deaths than other weather events. A heat wave is a prolonged period of excessive heat, often combined with excessive

humidity. Generally temperatures are 10 degrees or more above the average high temperature for the region during summer months, last for a long period of time and occur with high humidity as well. The heat waves are seasonal and lasts from April to June, the chances of getting a heat stroke are high during this period. Heat stroke (also known as sunstroke) is a life-threatening condition in which a person's temperature control system stops working and the body is unable to cool itself.

7.7.6 Man-made Disasters

Man-made disasters like terrorist attack, fire and explosion have been detailed in this section.

Fire and Explosion

Fire or explosion is a common hazard that may arise from the use of flammable liquids or gases that are easily ignited. The presence of large quantities of dry fabric or paper can also increase the risk and spread of fires. Faulty electrical wiring can also cause fires. Another source of risk is corrosive chemicals which can cause serious burns and may react dangerously with other chemicals. Few measures to tackle fire scenarios are listed below:

- Probable ignition sources like open flame and welding sparks, which may trigger fire, should be avoided to the extent possible at the plant site
- Fire fighting systems should easily accessible to minimize the impact of fire
- Fire alarms should be installed in order to raise early warning so that immediate actions can be taken.
- Training comprising causes of fire, fire fighting methods and equipment, response procedures etc. to all plant personnel should be provided

War Attack / Terrorist Attack

No solution can be offered to eliminate either terrorist threats or planted bombs, but one can be well or badly prepared to cope with them when such incidents happen. It is essential for organizations to design and implement both good physical security and a comprehensive bomb threat response plan. Following measures are recommended

- Safe evacuation of all staff would be ensured at the site in small groups but away from normal assembly points.
- Care would be exercised to distribute the staff in small groups preferably away from known assembly points. This is required as terrorists may send bomb scare at site and then explode devices by remote at assembly points to inflict greater damage.
- Bomb snuffing and diffusing squad would be requested from the police.

- All transport vehicles incoming and outgoing would be checked for unidentified objects.
- No personnel would be allowed to remain at site until site is declared safe
- In case of any terrorist attack at plant area, efforts would be made to protect life of the people. No action should be taken in haste by anyone as it could be misread by the terrorists. Police and other agencies would be informed and all support would be extended to them.

7.7.7 Assembly Points

Assembly points shall be set up farthest from the location of likely hazardous events, where pre-designed persons from the works, contractors and visitors would assemble in case of emergency. Up-to-date list of pre-designed employees shift wise must be available at these points so that roll call could be taken. Pre-designated persons would take charge of these points and mark presence as the people come into it. Two alternate locations for safe assembly points should be earmarked at all the operating plants. These locations are designated for assembling non-essential workers, visitors, and other persons who are not required in the plant site at the time of emergency but they are to be moved to safer places. These locations have been provided with sign boards displaying "Assembly Points" for easy identification.

The persons required to be assembled at the assembly point should choose safer assembly point out of the two, considering the wind direction at that time. The plant control room will also announce the same on the plant PA system, if possible. The person assembled at the assembly point shall follow the instruction for evacuation of the plant area and move to safe locations as directed. They should move in the cross wind direction or up-wind direction, whichever is more safer.

7.7.8 Mock Drills

Mock drills are very important in order to handle emergency scenarios in an effective way. It should be ensured that mock drills of the on-site emergency plan are conducted every six months. A detail report of the mock drill conducted shall be made immediately available to the concerned plant authority. Additionally, major fire and minor fire mock drills are conducted once in three months and one month respectively. Performances during the mock drills should be reviewed by top plant authorities. Observations / shortcomings should be reviewed and recommendations for improvements should be made. The action points from the mock drill observations should be circulated to all concerned for liquidation.

Part B: Public Consultation

Humble request to consider the present modernization proposal of ADP-1 **under para 7(ii) (a) of EIA notification 2006, amended on dated 23.11.2016.**

M/s Nayara Energy has applied for environmental clearance for expansion of Refinery from 20 MMTPA to 46 MMTPA along with 10.75 MMTPA Petrochemical Complex, EC for which is under consideration at MoEF&CC.

The present proposal “Asset Development Project-1 (ADP-1)” is a small part of the total Refinery Capacity Expansion Project, and involves production of 450 KTPA Polypropylene (PP) by revamping FCC Unit and unsaturated LPG stream of the existing refinery. The revamping of FCCU will bring some changes in the product slate of the existing refinery, however the total crude throughput shall remain same (20 MMTPA).

Thus, the proposed ADP-1 project is a modernization project with change of product mix in existing units, while the overall throughput remains same, exemption of Public hearing under para 7(ii) (a) of EIA notification 2006, amended on dated 23.11.2016 is requested. The project does not envisage any significant load on the environment, as there is no furnace in these units (hence no air pollution) and effluent generated will be treated in existing units, and there is no Hazardous waste load due to this modernization project. Therefore, humble request to exempt Public Hearing and grant environmental clearance.

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Chapter 8

Project Benefits

Chapter 8

Project Benefits

8.1 Introduction

The proposed developmental activity in this region will result in improvement of infrastructure as well as upliftment of social structure in the area. The people residing in the nearby areas will be benefited indirectly. It is anticipated that the proposed ADP-1 project will provide benefits for the locals in two phases i.e. during construction phase as well as during operational phase.

The major benefit envisaged from the project is that it will boost industrial development of the region due to availability of petroleum products to Country/State and industries concerned. As a result, there would be more opportunities for employment generation to the locals, especially the youths. Approx. 7000 workers (peak requirement) are estimated to be employed during construction phase, and about 150 persons will get employment in the project during the operation phase.

The company also proposes to provide training to local youths, so that their skills can be gainfully utilized in project activities. The project will create opportunities for direct employment. The project will also create opportunities for indirect employment due to increase in trades viz. stockist / retailers of building material, groceries, provision shops, medical stores, garment shops, furniture shops, hotel & restaurants, etc. in the region to meet the increased requirements.

8.2 Construction Phase Benefits

8.2.1 Employment

The major benefit due to the proposed project will be in the sphere of generating temporary employment for substantial number of personnel. On an average about 3300 persons would be required for 2 years during the construction work; most of them would be unskilled as well as skilled workers. The requirement during peak construction period may be upto 7000. This means temporary employment to the tune of about Rs. 140 Crore in about 2 years. These construction workers shall be taken from the study area to the extent possible. Hence, the proposed project will benefit locals to a large extent.

8.2.2 Community Services

Nayara Energy shall employee suitable local people to the extent possible in order to reduce the need for additional infrastructure. In addition, Nayara Energy shall

develop necessary infrastructure like accommodation, water supply, sewerage, medical facility, etc. for catering to the needs of the project personnel and their families. The local people will be indirectly benefited by these developments.

8.3 Operational Phase Benefits

8.3.1 Improvement in Petroleum Product - Polypropylene Availability

Petrochemicals play a vital role in the functioning of virtually all key sectors of economy which includes agriculture, infrastructure, healthcare, textiles and consumer durables. Polymers provide critical inputs which enable other sector to grow. Petrochemical products cover the entire spectrum of daily use items ranging from clothing, housing, construction, furniture, automobiles, household items, toys, agriculture, horticulture, irrigation, and packaging to medical appliances.

India's strong economic growth will drive a phase of rapid demand growth in downstream plastics processing, with PP demand forecast of 8-9% for next 10 years as per market reports of various global petrochemical consultants. Rapid urbanisation, young demography and growing income supporting strong PP demand growth in India.

There is significant upside potential for per capita PP consumption in India. Current consumption is only 3.8 kg per annum, compared with the global average of 9.4 kg and 20 kg observed in developed economies such as the US.

Average annual incremental PP demand in India expected to be 540 KTPA during period of 2018 to 2022 which necessitates world scale capacity addition every year.

High population, relatively low per capita consumption and expected high economic growth should propel India's polymer consumption to new levels in future. Historically demand of PP has grown at 1.5 times of GDP growth in India and it is expected to grow at minimum 8% per year in future. Current PP demand of 5.5 MMTPA (year 2019-20 estimate) is expected to reach 8.8 MMTPA by year 2025-26 with this 8% growth rate. This demand growth likely to create need of 3.0 MMTPA PP capacity addition in India by 2025.

Production of Polypropylene from the existing refinery shall reduce the demand and supply gap in the State/Country.

8.3.2 Livelihood Opportunities and Direct & In-direct Employment

During the operational phase, about 150 people shall be employed. Proposed project would add to the livelihood opportunities in the study area, which will result in better scope for direct employment etc.

In addition to the direct employment mentioned above, there will be indirect employment of local people by utilizing their expertise in different areas like horticulture, site clearing, etc. Also, due to secondary development in the study area, employment

opportunities will be generated. Approximately 7000 people are expected to get direct and indirect employment out of the proposed project activities.

8.4 Community Welfare Measures

NEERI teams during field studies have interacted various stakeholders/ representatives of different groups, and their concerns have been noted. Further, public consultation was done by inviting written concerns/comments from the possible stakeholders. Accordingly, comprehensive social/ community development activities shall be worked out, in addition to the various CSR activities already being done in the region by Nayara Energy (indicated under Section 3.6.4 of this report). The project in general would accelerate the overall socio-economic development of the region by way of direct and indirect taxes, resources utilization, employment and infrastructure development. Further, measures would be adopted to minimize/mitigate the adverse impacts, if any.

At Nayara Energy, Corporate Social Responsibility (CSR) has been an integral part of its business strategy. Nayara Energy appreciates the social and economic diversity in the Country and has consciously embedded the community engagement dimension in its business planning, risk and reputation management processes. The CSR initiatives of Nayara Energy have played a pivotal role in improving the quality of life of the communities living in the vicinity of operations of the Company.

Nayara Energy's vision is to be among the most respected organizations in India by doing what is right and rightful for the communities and nation at large. Nayara Energy aspires to build a symbiotic relationship with its stakeholders and intends to make them equal partners in the process of nation building. It firmly believes that their role is to lay the path that is collaborative, progressive, inclusive and sustainable through various CSR programs. It also believes that technology and innovations can hasten the process of change and endeavour to support new and innovative models of development.

Nayara Energy Ltd. runs the CSR activities majorly in following key areas:

- Health and Sanitation
- Education
- Livelihood Development
- Sports Promotion
- Women Empowerment
- Infrastructure Development
- Environmental Sustainability

Various activities are undertaken in the above key areas in the study region and it has so far touched the lives of more than 4 lakh people during 2014-17.

For proposed ADP-1 Project, it is proposed to invest 2% of its average net profits on different CSR activities, as per the suggestions/demands of the people of the region. To achieve the objectives in the thematic areas, CSR activities shall be planned in participatory mode involving the local residents for the activity identification and at planning stage.

8.5 Green Belt Development

Besides the green belt development within the existing refinery premises in 33% of the total land area for the project, mass plantation movement shall be initiated within 10 km area of the project under Community Environment initiative. It is planned that under this initiative, eco-clubs shall be organized in schools with memberships of school students and teachers. Mass plantation drive shall be executed through eco-clubs.

In summary, the proposed site for setting up the Asset Development Project-1, i.e. production of 450 KTPA polypropylene using the existing refinery feedstock and facilities is needed for the bridge the gap between demand & supply. The project site is slightly undulated with scrub vegetation, barren land and some agriculture land. Therefore, it will not involve loss of vegetation, and biodiversity will not be affected as the vegetation is similar in the whole area with no sensitive ecosystem or rare and endangered flora or fauna, and hence no environmental loss will be there in terms of net productivity value.

The project cost, expenditure and budgetary provision on the implementation of the Environmental Management Plan (EMP) are presented in EMP of Chapter 9 of the report. Besides the tangible benefits, the project has got number of intangible benefits like use of latest world class technologies for manufacture of polypropylene resulting into maximum recovery of product and minimum emissions/wastes, minimal/acceptable impact on environment, socio economic benefits to the local people and the region and enhancement of the availability of petroleum product for the country.

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Chapter 9

Environmental Cost Benefit

Chapter 9

Environmental Cost Benefit

The proposed site for setting up the Asset Development Project-1 (ADP-1) is within the existing refinery premises. The site is mostly flat with little-bit undulation with scrub vegetation, barren land and some agriculture land. Therefore, it will not involve loss of vegetation, and biodiversity will not be affected as the vegetation is similar in the whole area with no sensitive ecosystem or rare and endangered flora or fauna and hence no environmental loss will be there in terms of net productivity value.

The project cost, expenditure and budgetary provision on the implementation of the Environmental Management Plan (EMP) are given in Chapter 10 of the report. Besides the tangible benefits, the project will have number of intangible benefits like use of latest world class technology for polypropylene production resulting into maximum recovery of product and minimum emissions/wastes, minimal/acceptable impact on environment, socio economic benefits to the local people and the region and enhancement of the availability of polypropylene for the country.

Proposed project shall have social benefits in terms of large-scale employment during construction phase as well as during operational phase. With effective implementation of pollution control measures coupled with adoption of environment management plan followed by environmental monitoring, the project shall leave overall positive impact on the overall development of the region.

Chapter 10

Environmental Management Plan

Chapter 10

Environmental Management Plan

10.0 Environmental Management Plan

The Environmental Management Plan (EMP) provides an essential link between predicted impacts and mitigation measures during implementation and operational activities. EMP outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or mitigate adverse environmental impacts, and the actions needed to implement these measures.

The likely impacts on various components of environment due to the project during developmental activities have been identified and measures for their mitigation are suggested for the proposed Asset Development Project-1.

The EMP comprises a series of components covering direct mitigation and environmental monitoring, an outline of waste management plan and a project site restoration plan. Therefore, environmental management plan has been prepared for each of the above developmental activities.

All the recommendations made in the EIA / EMP and Risk Assessment Reports in respect of environmental management and risk mitigation measures relating to refinery have been implemented, as applicable for the existing refinery.

The status of EC compliance certified by MoEF&CC regional office, Bhopal with latest data for the year 2017-18 for the existing refinery is given in **Annexure 8**. Certified compliance report for CRZ, FCA and WLCPA clearances is given in **Annexure 9**.

For the proposed ADP-1 project, the following EMP is suggested during construction phase and operational phase of the project.

10.1 EMP during Construction Phase

10.1.1 Site Preparation

Environmental pollution during construction stage will be limited, and for a temporary period, during that activity. Construction shall be planned in such a way that excavated material shall be disposed safely. The manpower required for these activities shall preferably be employed from nearby villages so that avenues of employment will be open to local people.

Directly or indirectly all the environmental components get affected due to the construction activity. The following environmental protection measures are suggested for implementation by the contractor or the authority during the construction as applicable.

10.1.2 Air Environment

During the construction phase, gaseous emissions are expected from the heavy machineries deployed for construction, where all the emission sources are intermittent. Though the gaseous emissions are not expected to contribute significantly to the ambient air quality, some generic measures to reduce fugitive and gaseous pollutants emissions during construction phase from point, area and line sources shall include the following:

- The storage and handling of soil, sub-soils, top-soils and materials will be carefully managed to minimize the risk of windblown material and dust
- Those sections of the working area, which experience traffic will be sprinkled with controlled application of water sprays (e.g. by water dowsers) as conditions dictate. Treated wastewater from the existing refinery/power plant shall be used for this purpose.
- There will be no on-site burning of any waste arising from any construction activities
- All vehicles delivering construction materials or removing soil will be covered to prevent escape of dust
- Idle running of Engines will not be allowed
- Engines and exhaust systems of all vehicles and equipment will be maintained so that exhaust emissions do not exceed statutory limits (set for that vehicle/equipment type and mode of operation by CPCB), and that all vehicles and equipment are maintained in accordance with manufactures' manuals
- Exhausts of other equipment used for construction (e.g. generators) will be positioned at a sufficient height to ensure dispersal of exhaust emissions and meet the standards set by CPCB.
- Dust masks would be provided to construction workers, while carrying out operations that may entail potential for dust generation.

10.1.3 Noise Environment

The following measures are recommended to mitigate adverse impacts on noise environment during construction phase:

- Onsite workers shall be provided with noise protection devices such as ear plugs/ ear muffs wherever necessary
- Earth movers and construction machinery with low noise levels will be used
- Periodic maintenance of construction machinery and transportation vehicles shall be undertaken; to ensure that noise levels remain within the limits.

10.1.4 Water Environment

Measures for Supply of Water

- The region being water scarce, the project developer would not extract fresh water from any water bodies (surface or groundwater) for the construction phase of the project.
- No existing resources/ fresh water sources (surface/groundwater) which are currently being used by the villagers for the purpose of obtaining drinking water and/or water for irrigation or other purposes, would be tapped.
- The water shall be supplied from the existing water resources of the refinery for construction purpose. Treated wastewater from the existing facilities of the refinery will be utilized.
- Drinking water requirements during the construction phase by the contractors would be met from refinery resources or packaged water/water transported through tankers to the construction sites.
- Construction labourers shall be provided with adequate quantity of drinking water of potable quality.

Mitigation Measures for Prevention of Water Pollution

- Two major sources of potential impacts arise during construction phase; uncontrolled runoffs from the labour camps, and accidental spills of oil etc. The selected contractor would be obligated to follow the procedures so as not to pollute groundwater.
- Sufficient and appropriate sanitary facilities would be provided in order to maintain hygienic conditions in the camps of construction labourers. These measures will adequately mitigate the possibility of any negative impacts during construction on terrestrial water quality.
- The wastes, such as, sanitary wastes should be treated in septic tanks followed by soak pits of appropriate size and technology. The existing facilities available in refinery premises would be extended to construction workers.
- The solid waste generated shall be collected and disposed in an appropriate manner either at a landfill site or used as compost for agricultural uses.
- The existing workshop areas shall be used for the maintenance of vehicles and construction machineries so as to avoid accidental spills of oil/oily wastes. Area for maintenance of vehicles shall be so located that contamination of groundwater by accidental spillage of oil can be prevented.

10.1.5 Land Environment

- Workers engaged during construction phase shall be provided with temporary housing facilities at planned labour colonies located nearer to project site. Haphazard growth of labour camps would be avoided.
- On completion of construction works, all temporary structures, surplus materials and wastes would be completely removed. Dumping of construction waste on agricultural land would be prohibited and stockpiles would be provided with gentle slopes.
- Since no additional land is required for the proposed project, land for project development will not result in changes in the landscape and land use in the region. However, it would be ensured that the proposed land use for the project development is compatible with the surrounding land use.
- The solid wastes such as paints, lubricants, oil, diesel containers or any other non-biodegradable wastes that have leachable constituents would be disposed as per the "Authorisation' received from GPCB.
- A waste management plan would be prepared or integrated with existing plan before the commissioning, and would be implemented and monitored. In areas, where soil quality for natural vegetation is of critical concern, loosening of soil in such areas will be done to mitigate soil compaction caused due to operation of heavy machinery.

10.1.6 Biological Environment

The region does not have dense vegetation and land use is dominated by rain fed agriculture activities. Following measures are recommended to mitigate adverse impacts on biological environment during construction phase:

- There would be minimal removal of vegetation
- Re-vegetation would commence at the time site clearing is being undertaken
- Number of trees replanted would be at least two times of trees removed.

10.1.7 Socio-economic Environment

- Given that the project and related developments like construction camps will not be dependent on local resources (power, water), during both construction and operations, the only likely impact on infrastructure would be on the roads, especially SH 25 during the construction phase, however, the additional movement of trucks would be marginal.

10.1.8 Health and Safety

- The movement of heavy equipment would be done with proper precaution to prevent any accidents on the road. Occupational risk would be minimized at the project site through implementation of a full proof safety system. Speed limit set for movement of vehicles with 20 km/hr on village roads to reduce risks of accidents or injuries.
- Safety training would be provided to all construction workers on operation of equipment. Security would also be extended during non-working hours to ensure there is controlled access to the machinery and equipment.
- The contractors would also be vigilant to detect workers showing symptoms of communicable diseases. All contract labors would be vaccinated. All illness and incidents would be reported and recorded.

10.2 Environmental Management Plan during Operation Phase

In order to mitigate the impacts due to capacity expansion of refinery on various environmental components, the following measures are recommended:

10.2.1 Air Environment

During operational phase of ADP-1 Project, no air emissions are expected. The proposed Polypropylene Plant will have only one additional stack/vent, which will be attached to the thermal oxidizer unit, which will be operated occasionally, when a specific grade of PP will be produced. The Thermal Oxidiser is basically an air pollution control system that is provided to control VOC emissions. ***Hence, there will be no emissions of SO_2, NO_2 or PM from the Polypropylene Plant on daily basis.***

The height of the stack/vent shall be only 30 m with diameter of 1 m, flue gas temperature of about 125°C and velocity of 11 m/s, and the impact of emissions during operation of thermal oxidizer shall be insignificant, and will not affect ambient air quality of the surrounding region.

The Refinery has to ensure operation of thermal oxidiser to control VOC emissions, whenever specific grade of PP is produced in the ADP-1 Plant.

The Refinery shall continue to strictly follow the EC and CTE/CTO conditions as well as various pollution control measures along with monitoring of the parameters for the existing refinery.

Following measures are being implemented in existing refinery. Same will be continued after ADP-1 project.

- Regular record on sulphur dioxide emissions shall be maintained at the refinery as part of the environmental data records
- Off gases from proposed units would also be treated in amine absorption and regeneration unit meant for H_2S removal as already in practice for desulphurization of off gases (fuel gas) from existing units

- Performance evaluation of Sulfur Recovery Units with Tail Gas Treatment Units would be done on regular basis (at scheduled intervals) through monitoring off gas flow rate, H_2S concentration at inlet and outlet and efficiency of sulfur recovery process
- In case of any failure in sulfur recovery units, appropriate steps would be taken to match the H_2S generation with SRU feed
- FCCU would have particulate control systems such as cyclones etc.
- All the combustion units shall be maintained properly at optimum efficiency
- All fuel combustion units would be operated with minimum excess air so that fuel consumption is optimized. The emission of NO_x is minimised by implementing Tangential/low NO_x burners in all combustion units of the proposed project
- Energy conservation projects/schemes to result into reduction in quantity of fuel would be implemented
- Low NO_x/Ultra low NO_x burners would be installed in furnaces, heaters and boilers for petrochemical units
- Leak detection and repair (LDAR) program would be implemented in petrochemical plant as well as in refinery
- Flares shall be designed with steam injection facility for refinery as well as for petrochemical plant.
- Port holes and sampling facilities should be provided at proper location for all new stacks coming up under proposed expansion project for monitoring of flue gas characteristics (velocity, flue gas temperature) and also for checking concentration of different pollutants at regular intervals
- Refinery would comply with applicable emission standards of CPCB/ MoEF&CC for the existing and proposed units
- Ambient air quality with respect to PM_{10}, $PM_{2.5}$, SO_2, NO_x, H_2S, CO, HC and VOCs monitoring shall be continued at appropriate locations in the impact zone
- Inventory of odorous compounds would be maintained and release of such compounds would be prevented
- Continuous online analyzers would be installed in all stacks as per recommendations of CPCB notification or GPCB prescription.
- Stacks of sufficient height (CPCB norms) shall be provided to ensure adequate dispersal of pollutants
- Gas powered or low sulphur diesel and unleaded petrol fueled vehicles will be used within the project area and for product evacuation.

- Waste oil will not be incinerated and will be sold to MoEF&CC/CPCB/ GPCB authorised waste oil recyclers
- Idling of vehicles will be minimized during transport and handling activities
- Loading/unloading and storage areas would be paved to reduce dust emissions
- All access roads (internal as well as external) to be used by the project authorities will be paved (either with WBM, concrete or bitumen) to suppress the dust generation along the roads
- Fuel leaks would be prevented from on-land equipment. Further, installation of leak detection systems and leak detection tests on fuel systems shall be done including distribution lines and tanks as per guidelines of CPCB/GPCB
- Emissions from individual stacks would be complied with the emission standards stipulated by MoEF&CC/CPCB and GPCB
- VOC emissions would be controlled through proper operation/ maintenance practices in petrochemical plant.
- Efforts will be made to minimize CO_2 emissions from the refinery operations.

10.2.2 Noise Environment

The design of the project will be such that the sound pressure level in the work area will not exceed 85 dB(A), the limit prescribed by National Institute for Occupational Safety & Health (NIOSH). Restricted areas will be those locations where it is not reasonably practicable to reduce the noise level below the work area limit. Wherever practicable, attempts shall be made to reduce the noise level below 85 dB (A) for 8 hours exposure duration. The noise levels will not exceed 60 dB (A) at the Boundary of the project site.

The equipment will be chosen in such a way that the above noise limit is not exceeded. The noise levels at the nearest habitation after refinery expansion will be less than the stipulated standards of CPCB. However, as a good operational procedure, the following generic measures will be implemented in addition to the existing green belt:

- Job and location specific noise levels shall be monitored or compliance with HSE regulations by verifying acceptability of noise levels caused by the project activities and comparison with noise criteria.
- Periodic audiometric tests for employees working close to high noise levels, such as compressors, DG sets, the loading and unloading sections would be conducted.
- Provision of PPE's will be done and their proper usage will be ensured for eardrum protection of the workers as well as visitors.

- It would be ensured that low noise (generating) equipment are procured wherever feasible for the proposed project.
- Acoustic barriers, and silencers would be used in equipment wherever necessary.
- Sound proofing/glass panelling would be provided at critical operating stations/ control rooms.
- Either Acoustic barriers/ shelter shall be developed in noisy workplaces or acoustic enclosures shall be provided for the high noise generating equipment.
- Noise generating sources in the plant areas would be monitored regularly.

10.2.3 Water Environment

- Since fresh water is a scarce resource in the area, only seawater shall be used for proposed expansion project. Additional Desalination Unit shall be installed to meet the water requirement of the proposed project.
- The existing WWTP is sufficient to handle the effluent generated from the ADP-1 Project.

Following measures are being implemented in existing refinery. Same will be continued after ADP-1 project.

- The performance of existing ETP would be continuously monitored and any deviation in performance would be corrected on priority.
- Reuse of effluent e. g. stripped sour water in de-salter would be attempted
- Recycle of pump gland cooling water would be undertaken
- Condensate recovery would be maximised
- Use of desalinated water as service water would be minimised
- Treated effluent would be used for hydro-testing of vessels/tanks/pipelines instead of desalinated water. Treated effluent would also be used for cleaning of columns/vessels during turnaround
- Guard ponds has been provided so that bio-systems of wastewater treatment system would be prevented against shock load
- Dosing of chlorine or biocides as part of advanced cooling water treatment in the cooling water system would be done to take care of biological growth

- The detailed record of raw water intake at refinery and wastewater generation from different sources shall be maintained on daily/ regular basis w.r.t. flow rates and characteristics. These details would be useful in preparing comprehensive water balance at project site and also for identification and implementation of reuse/recycle of entire treated effluent at the project site.
- Water flow measurement facilities (metering) shall be provided at inlet and outlets of major process units, which shall help in minimizing wastage, conserving the water as well as maximizing the recycle/reuse of treated effluent
- Regular monitoring of treated wastewater would be undertaken.
- Performance evaluation of effluent treatment plant would be undertaken at regular intervals for all relevant parameters.

10.2.4 Land Environment

During operational phase of ADP-1 Project, hazardous waste, if any, shall be managed as per present practices of the existing Refinery, meeting the Hazardous and other wastes (management & transboundary movement) Rules 2016.

Following measures are being implemented in existing refinery. Same will be continued after ADP-1 project.

- Soils in the adjoining areas are sandy loam to silty loam with moderate infiltration rates, amenable to groundwater pollution. Considering this fact, every precaution would be taken to avoid spillage of oils and other petroleum products on soils to protect groundwater and to avoid any danger to other soil microbial groups which are sensitive to oil pollution
- Oil is a potential hazardous substance present in wastes generated from refinery. Special care shall be taken in all oil removal operations. Disposal of Oily sludge generated from effluent treatment plant through Coker shall be continued. Oily sludge from other locations may be disposed off by co-processing/recycling/secured landfill/incineration
- Greenbelt in and around the refinery will be strengthened/maintained
- A record w.r.t quantity, quality and treatment/management of solid/ hazardous waste shall be maintained at environmental monitoring cell for different process units (sources)
- Mixers and in-situ tank cleaning procedures which maximise recovery of oil would be adopted to reduce tank bottom sludge
- Recovery of oil from oily sludge using techniques such as centrifuging, thickening and filtration would be undertaken.

Green belt Development Plan

- Nayara Energy has already developed a large green-belt along the periphery of the refinery. Some plantation will be done along the boundary of ADP-1 Project as appropriate. However, additional green belt is not proposed in this project.

Hazardous Waste Management

Hazardous waste generation from the ADP-1 Project shall becatalyst/ adsorbents from PRU and PPU (once in 4 years).

Existing hazardous waste management facilities are sufficient to handle the additional waste from ADP-1. Further, Hazardous and other wastes (Management & Transboundary movement) Rules, 2016, stipulated by MoEF&CC shall be followed, along with any rules/ guidelines prepared by the State Govt. in this regard.

10.2.5 Biological Environment

No additional measures are required, except some plantation/greenery development in the vicinity of the proposed PRU & PP units, at suitable locations.

Conservation Plan for Indian Peafowl

An Indian Peafowl or Peacock (*Pavo cristatus*) is a large pheasant justifiably declared as the National Bird of India in 1963 due to its flagship value and beautiful feathers. It is protected under Indian Wildlife (Protection) Act 1972 and was reported from the some villages within the study area during site visit. There is need to conserve our national bird in its habitat. Major threats to the peacocks in the area are:

- Habitat loss, specially the shortage of tall trees in and around the villages for roosting and for providing shade during hot summer months
- Shortage of drinking water for the birds during the hot summer days
- Casualties caused by eating chemically treated agricultural crop seeds
- Illegal hunting by some communities
- Vehicular movement in and around the forest area

Conservation Measures

Direct and indirect approach is required to provide effective conservation, which is recommended as under:

Food and Feeding habitats: Peafowls are omnivores, eating plant parts, flower petals, seed heads, insects, and other arthropods, reptiles and amphibians. In the study

area dense tree canopy cover supports good insect diversity which is very common food for peafowls

Increasing the tree cover in the buffer area for shelter and roosting of peacocks. This will be achieved by planting of tree groves (a group of trees that grow close together, generally without many bushes or other plants) in buffer area. Some local species such as Neem, Siris, Amaltash, Ardu, Shesham, Dhak, Peepal, etc. will be planted. Planting of tree groves in school compounds in the villages of buffers area can be planted as per the plantation programme.

Seed Distribution among the Villagers: During this habitat improvement programme the seed of Bassia latifolia (Mahua), Tamarindus indica (Imli) and other seeds should be distributed in the various villages of the study area. Compost packets should also be provided at the intervals of the every six months by the proponent (in consultation with forest department).

- By conducting awareness programmes (community and school level) for conservation of peacocks in the area and also through organizing competitions during “Wildlife Week” and “Van Mahotsav” celebrations
- Some provision of rewards shall be provided to informers for the control of poaching and illegal trade in wildlife.
- Water Filling in the existing water bodies during summer: Water shall be filled in the existing (selected by forest department) water bodies by water tankers. Also, water containers shall be keep inside the forest area & need to check water level at regular intervals.
- Provision of veterinary care and cages for injured or sick deformed birds.
- Suggest strategies to minimize negative impacts of changing environment in nearby area of peacock populations and to promote conservation of peacock habitats.

Further suggestion/recommendations are:

- Stopping the increased vehicle pollution, wildlife road facilities and damaged to precious habitat by people movement towards these areas
- To carry annual census research project to know the potential threats and population status, ecology and habitat use by peacock.

Another way to help preserve the endangered species is to create dedicated society to ecological ethics. All the conservation measures will be implemented with the help of and in the consultation of the District Forest Department, Jamnagar.

With the objective of effectively protecting the wild life and to control poaching, smuggling and illegal trade in wildlife and its derivatives, the Government of India enacted Wild Life (Protection) Act 1972. The Act was amended in January 2003 and punishment and penalty for offences under the Act have been made more stringent.

10.2.6 Socio-economic Environment

No significant adverse impacts are envisaged due to the proposed ADP-1 Project. However, the company shall take appropriate welfare measures for the benefit of the locals/ socio-economic development of the region. Some of them are:

- Nayara Energy shall continue to undertake social welfare programs for the betterment of the Quality of Life of villagers in collaboration with the local bodies
- Some basic amenities, viz. education, safe drinking water supply to the nearby villages will be taken up
- Regular medical check-up shall be continued on routine basis in the villages around the refinery and also by providing mobile hospital services
- Formal and informal training to provide direct and indirect employment to the affected villagers due to the project shall be taken up on priority
- Focus shall be on literacy program in collaboration with local government under "Sarva Shiksha Abhiyan" program and emphasis will be placed on female literacy. Wherever feasible, awareness on improved agricultural practices for increased utilization of land around will be taken up in collaboration with local government & panchayat.

10.3 Budgetary Allocation for Environmental Protection and CER Activities

Since the proposed project is a very small activity in comparison to existing refinery, the environmental management practices being followed in the existing refinery shall be adopted for the proposed project with suitable augmentation/creation of new facilities, as required to ensure that all the environmental quality parameters within the refinery premises and in the region remain within the permissible levels. Efforts will further be made to ensure adequate social welfare activities in region, resulting in overall development of the region with improved quality of life of the people in the region.

Adequate financial provision for environment protection measures shall be made. Air pollution control system (thermal oxidiser) for control of VOC emissions during production of specific grade of Polypropylene shall be installed. Tentative budget allocation for environment protection is about Rs. 10 Crore with recurring cost of Rs. 0.14 Crores per year.

Further, CSR budget projection for existing Refinery Business for next 5 years is given in **Table 10.3.1**.

Table 10.3.1: Proposed CSR Budget under CSR Activities for the Existing Refinery

Sr. No.	Focus Area	Annual Budget under CSR (Rs. in Crore)				
		2019-20	2020-21	2021-22	2022-23	2023-24
1.	Health & Sanitation	5.70	5.40	5.60	3.30	3.40
2.	Education & Skill Development	3.03	2.6	0.25	0.25	0.25
3.	Water & Livelihoods	3.3	6	8	10	10
4.	Rural Infrastructure Development	1.5	1.5	1.5	1.5	1.5

**Please note that the above-mentioned figures are just the projections, these number might change based on the final profit figures in coming years.*

CER Budget

In addition to CSR budget of existing refinery, a budget of Rs. 19.5 Crore (on Rs. 6200 Crores, as per MoEF & CC Notification dated May 1, 2018) has been allocated towards Corporate Environment Responsibility (CER). The expenditure shall be incurred as per the needs of the people of the surrounding villages/region. Some of the needs identified are given in **Table 10.3.2**.

Table 10.3.2: Tentative Projects to be Undertaken Under Corporate Environment Responsibility and Likely Expenditure Involved

Projects	Objective	Per Unit Cost (Rs. in Lakhs)	Total Unit Proposed (Nos.)	Proposed Budget for ADI-1 (Rs. in Lakhs)	Proposed Outcomes to be Achieved
Construction of Big Water harvesting structures	To conserve rain water and improve the quality of ground water	50	8	400	Around 700 Ha of additional land will be brought under Irrigation and 2.6 MCM of additional water storage capacity will be created
Developing a multi-speciality sports complex	To develop a good sport infrastructure	550	1	550	Youth from entire Dwarka will have access to better/affordable training facilities

Start-up fund for development of Micro Enterprises	To identify innovative business ideas suitable to local needs and to provide support for development of Micro Enterprises)	100	10	1000	Integrated Employment, Micro Entreprise and Entrepreneurship Development Program leading to employment generation to hundreds of people which will multiplier the local business growth potential in the region (The program will possibly be designed with UNDP)
			Total	**1950 (Rs. 19.50 Crores)**	

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Chapter 11

Summary and Conclusion

Chapter 11

Summary and Conclusion

M/s Nayara Energy Ltd., erstwhile Essar Oil Ltd., is operating a 20 MMTPA refinery complex at Vadinar, Devbhumi Dwarka, Gujarat. It is the second largest single location Refinery in India and is also among the top 5 most complex refineries in the world.

It is pertinent to mention that M/s Nayara Energy has applied for environmental clearance for expansion of Refinery from 20 MMTPA to 46 MMTPA along with 10.75 MMTPA Petrochemical Complex, EC for which is under consideration at Ministry of Environment Forests and Climate Change (MoEF & CC).

The present proposal "Asset Development Project-1 (ADP-1)" is a small part of the total Refinery Capacity Expansion Project, and involves production of 450 KTPA Polypropylene (PP) by revamping FCC Unit and unsaturated LPG stream of the existing refinery. The revamping of FCCU will bring some changes in the product slate of the existing refinery, however the total crude throughput shall remain same (20 MMTPA).

Since, this project is a part of the total Refinery Capacity Expansion Project, the baseline data collected for the Refinery Expansion Project during Summer 2018 has been used for this ADP-1 Project. Proposed ADP-1 Project shall take place at the land available within the existing refinery premises.

As per the Environmental Impact Assessment (EIA) Notification dated 14th September 2006 with amendments, the proposed project requires prior EIA study based as per the standard ToR issued by MoEF&CC. Accordingly, M/s Nayara Energy Ltd approached CSIR-NEERI to conduct EIA study for the purpose.

The present EIA report addresses the environmental impacts of the proposed ADP-1 Project, and suggests the mitigation measures along with Environment Management Plan and Environmental Monitoring Program. The EIA report is prepared based on the standard Terms of Reference (ToR) issued by MoEF&CC.

The proposed ADP-1 project is a modernization project with change of product mix in existing units, while the overall throughput remains same, exemption of Public hearing under para 7(ii) (a) of EIA notification 2006, amended on dated 23.11.2016 is requested. The project does not envisage any significant load on the environment, as there is no furnace in these units (hence no air pollution) and effluent generated will be treated in existing units.

The study has been presented in detail in 10 Chapters and salient findings of the study are summarized under Executive Summary provided in the beginning of the report.

The proposed modernization project will have negligible or may have certain level of marginal impacts on the local environment, however, with the implementation of the proposed pollution control and environment management measures, even the minor impacts anticipated due to construction and operation of the proposed project will be mitigated.

Further, development of this project will have certain beneficial impacts/effects in terms of bridging the Polypropylene demand and supply gap. This will also provide employment opportunities during construction as well as during operational phase of the project, and further social upliftment of the region through CER and subsequently continuous CSR initiatives by the Nayara Energy Ltd.

Thus, in view of considerable benefits from the project without any significant adverse environmental impacts due to effective implementation of EMP, the proposed project would be advantageous to the region as well as to the nation.

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Chapter 12

Disclosure of Consultants Engaged

Chapter 12

Disclosure of Consultant Engaged

12.1 CSIR-NEERI Profile

CSIR-NEERI (National Environmental Engineering Research Institute) is a Constituent Laboratory of CSIR (Council of Scientific & Industrial Research), India (Website: www.neeri.res.in) was established in 1958.

12.1.1 CSIR-NEERI Mission and Vision

CSIR-NEERI Mission:

The Institute dedicates itself in the service of mankind by providing innovative and effective solutions to environmental and natural resource problems. It strives to enable individuals and organizations to achieve productive and sustainable use of natural resources on which all life and human activity depend. Highly skilled and motivated, the Institute strives for excellence in environmental science, technology and management by working hand in hand with its partners.

CSIR-NEERI Vision:

CSIR-NEERI envisions a world in which;

- All individuals and Institutions have capacity to act in a manner that ensures achievement of sustainable environmental and economic goals.
- The natural balance is no longer threatened and all share the benefit of a healthy environment.

CSIR-NEERI would continue to strive for;

- Leadership in environmental science, technology and management domestically and worldwide.
- Strong and effective working relationship with its partners in ensuring ecological health of all regions in India.

12.1.2 Mandate of CSIR-NEERI

- To conduct R&D studies in environmental science and engineering.
- To render assistance to the industries of the region, local bodies etc. in solving the problems of environmental pollution.
- To interact and collaborate with academic and research institutions on environmental science and engineering for mutual benefit.
- To participate in CSIR thrust area and mission projects.

12.1.3 CSIR-NEERI Activities

R&D Thrust Areas:

- Environmental Monitoring
- Environmental Modeling
- Environmental Impact & Risk Assessment
- Environmental System Design
- Environmental Biotechnology
- Environmental Genomics
- Environmental Policy Analysis

Advisory:

- Central Govt. Ministries
- State Govt. Ministries
- Industries
- Judiciary

12.1.4 CSIR-NEERI Services and Goods

Research Intensive Areas:

- Air, Water, Wastewater, Soil (Land), Solid & Hazardous Waste
- Environmental Biotechnology & Genomics
- Environmental Materials

Public and Strategic Areas:

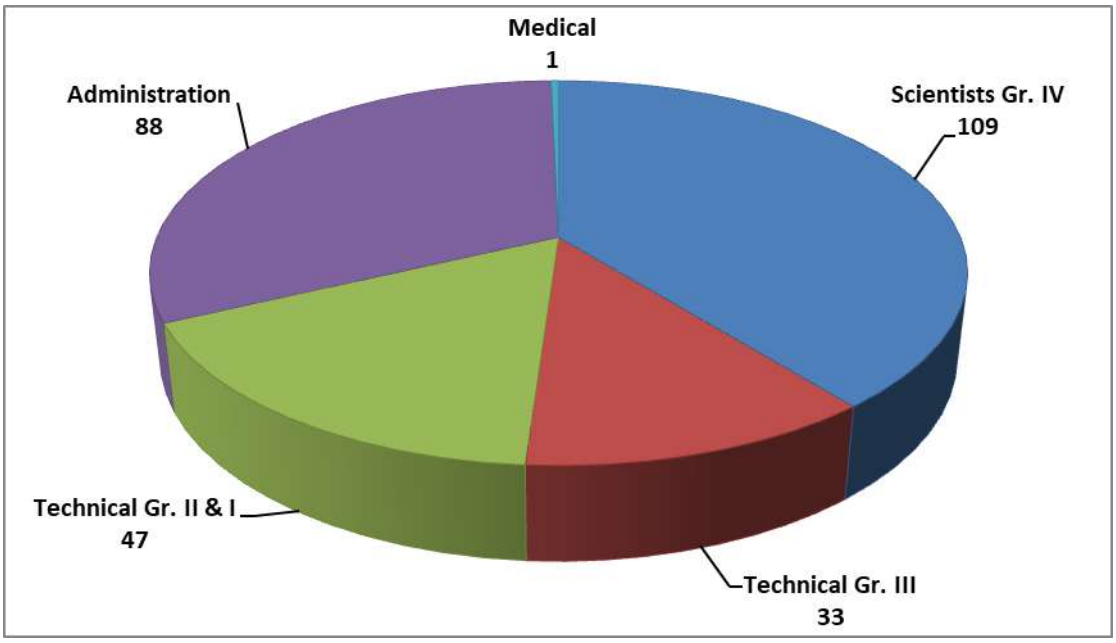
- Environmental Monitoring
- Environmental Policy Analysis

Socio-economic Areas (Urban & Rural):

- Drinking water
- Clean Air
- Environment & Health
- Advice to Central & State Government Agencies
- Judiciary

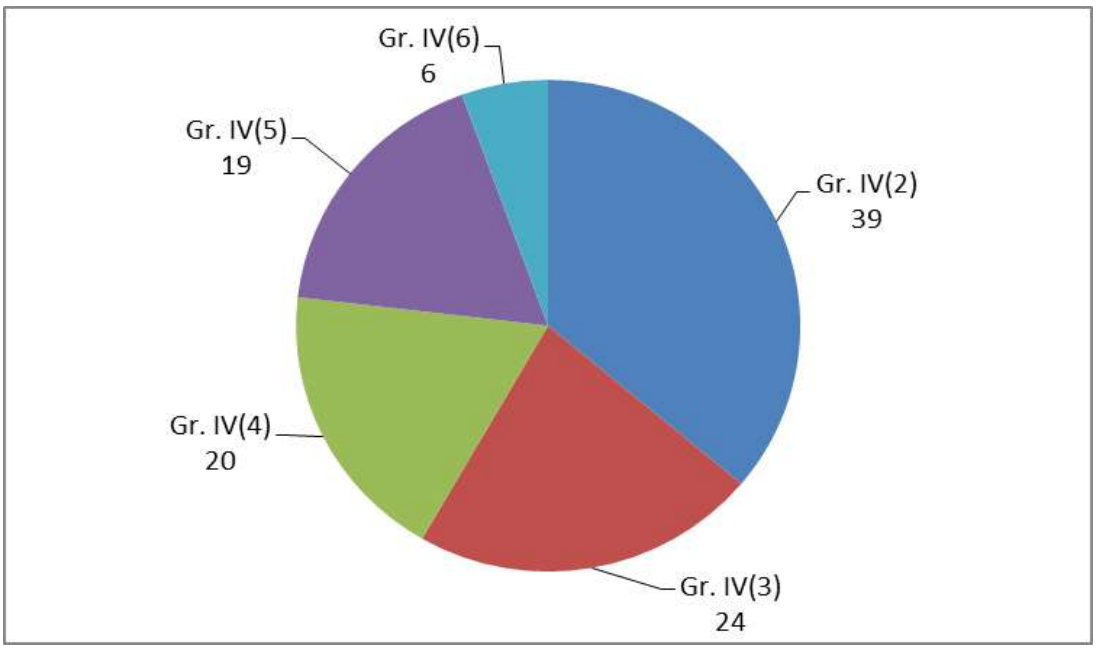
Industry Focus:

- Environmental Monitoring, Management and Audit
- Environmental Technology Assessment
- Environmental Impact & Risk Assessment



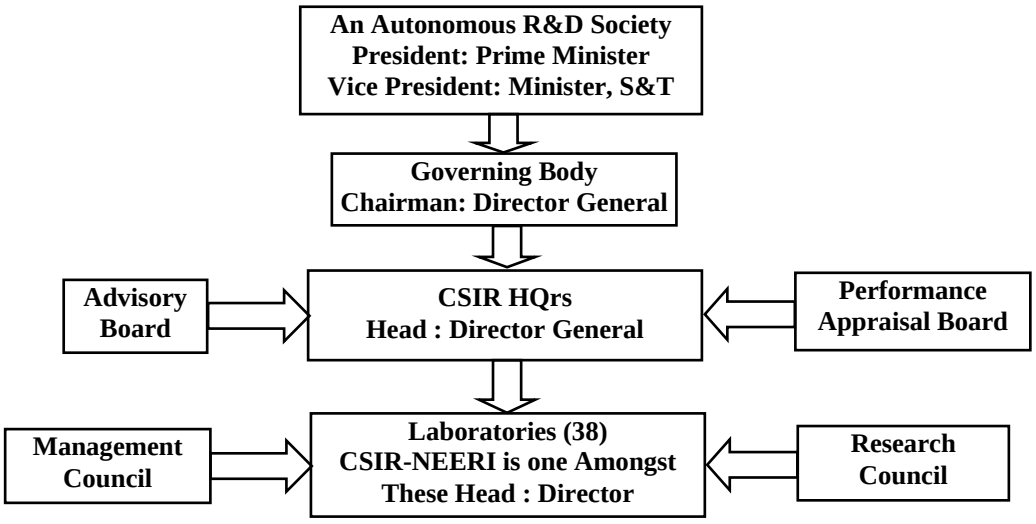
CSIR-NEERI: Human Resources (Total Manpower)
Total : 278 (As on December 31, 2018)

12.1.5 CSIR-NEERI Human Resources

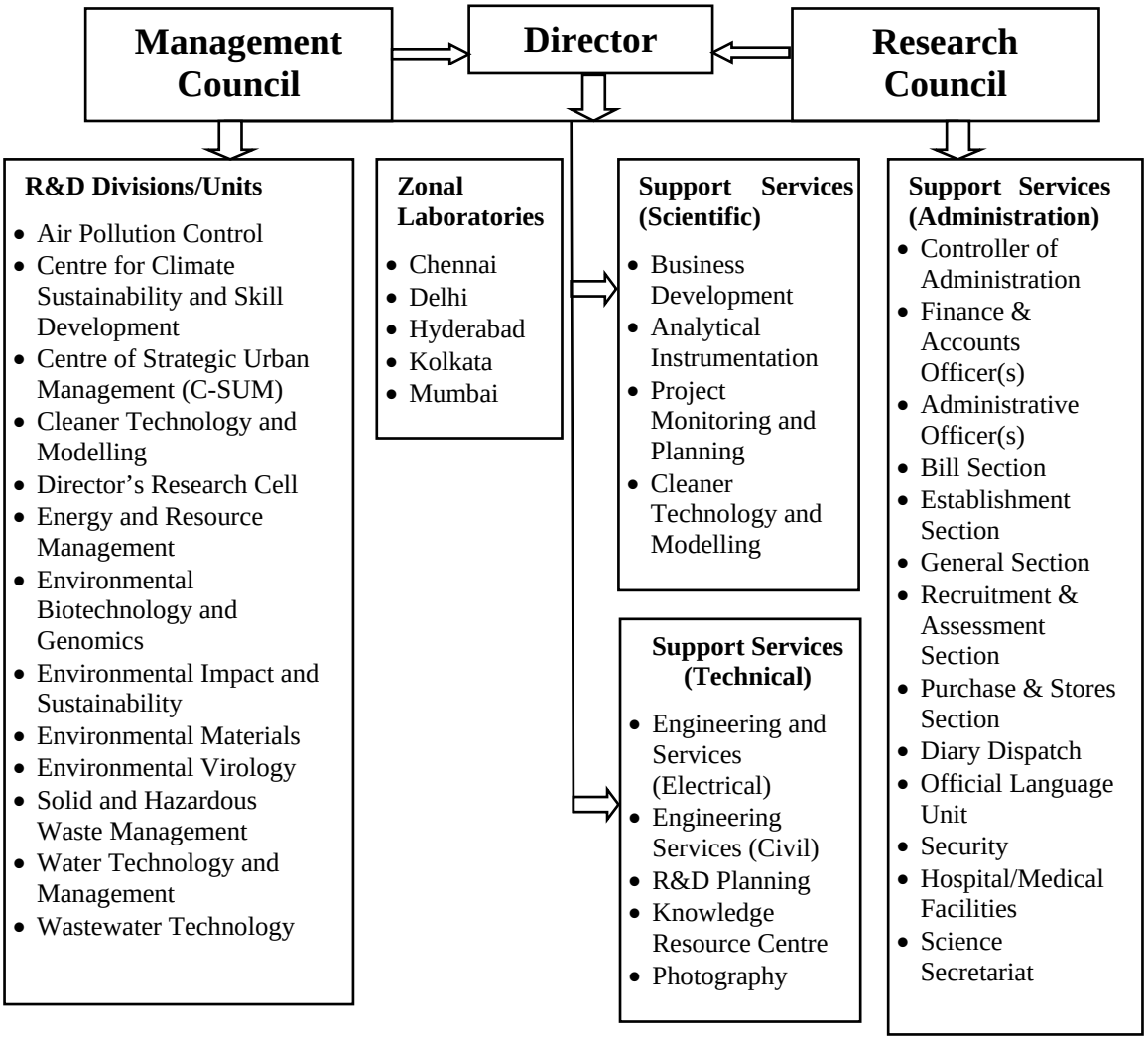


CSIR-NEERI: Human Resource – Scientific Staff
Total: 108 (As on December 31, 2018)

12.1.6 Organizational Chart of CSIR and CSIR-NEERI

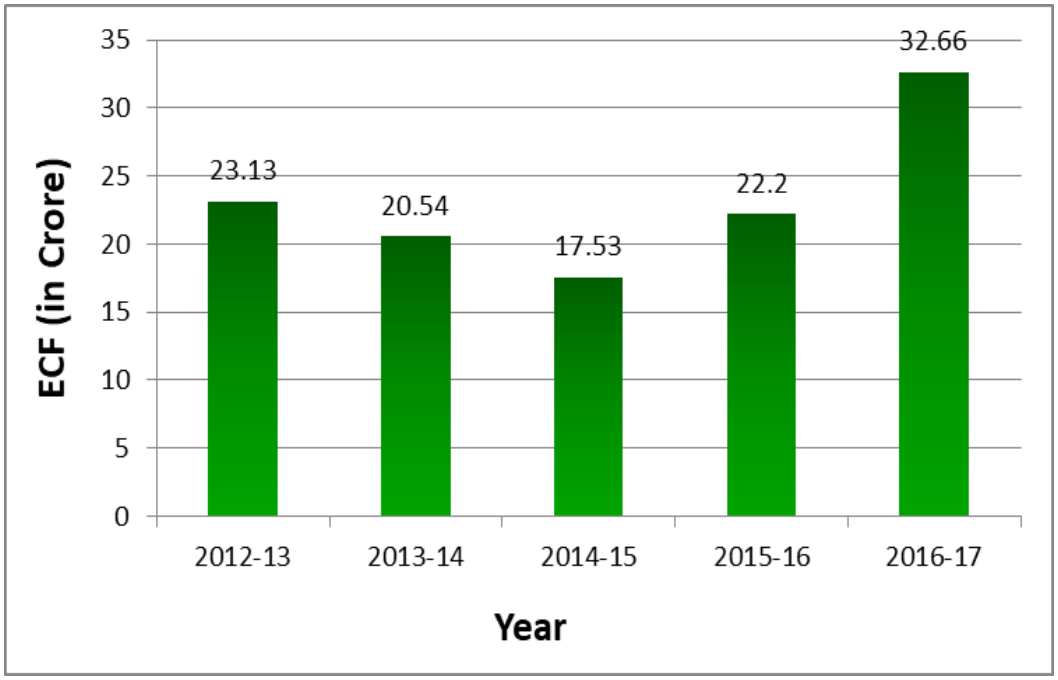


CSIR, India (Organizational Chart)



CSIR-NEERI: Organization Chart

12.1.7 Financial Resources of CSIR-NEERI



Financial Resources (2012- 2017) (in Crore) (ECF- External Cash Flow)

12.1.8 Analytical Instruments, Computer Systems and Software at CSIR-NEERI

12.1.8.1 Analytical Instrumentation Resource

- UV-VIS-NIR Spectrophotometer: Hitachi 330
- Atomic Absorption Spectrophotometer: GBC 904 A
- Fluorescence Spectrophotometers: Hitachi F-4000 & Hitachi F-4500
- Mercury Analyzers: Perkin Elmer MAS-50 A and MAS-50 B
- Gas Chromatographs: Perkin Elmer Autosystem – 5 nos.
- High Performance Liquid Chromatographs: Waters 204 and 501; Shimadzu-LC10
- Gas Chromatograph-Mass Spectrometer: Varian Saturn III
- Liquid Chromatograph-Mass Spectrometer-Mas Spectrometer: Quattro Ultima
- Ocean related studies: ADCP, CODAR, GPS, Ekmen Dredge, Reversible sampler, (Nishkin type) DRDF, Reversible thermometer, Tide Gauges
- Doppler SODAR
- Mini Sonde
- Microscopes
- Biolistic particle delivery system with accessories
- Gene Pulser II System with accessories & consumables
- Membrane Bioreactor Assembly

- Wet air Oxidation High pressure reactor
- Ground Penetrating Radar
- Multi Electrode resistivity Imaging system
- Ambient Ozone Analysers
- Eight Stage Cascade Impactor
- Microwave Furnace
- CHNS Analyser Vario ELIII
- Porosimeter Quanta Chrome PM33-7
- Mercury Analyser – Milestoen DMA80
- FTIR Spectrometer – Bruker Vertex 70

12.1.8.2 Computer Hardwares & Peripherals

Computer Hardware

- High performance computer systems configures around RISC workstations
- Sun Ultra Sparc Computer Station: Sun Ultra 1 Model 170
- Silicon Graphics 02 Workstations
- Silicon Graphics 2000 Workstations
- HP APOLLO 90001730 Workstations
- Personal Computers
- Laptop Computers
- Local Area Network

12.1.8.3 Supporting Software

- Geographic Information Systems – ARC INFO, MAP INFO
- Knowledge Based System – Prokappa
- Digital Image Processing – ERDAS, EASIPACE, PCI WORKS
- INGRES
- CADCORE
- SPSS
- IMSL
- COMPLIERS
- GRAPHICS
- MATLAB
- DIVAST

12.1.8.4 Software for Mathematical Modeling (Available at CSIR-NEERI)

Air Environment:

Model	Used for Predicting Impacts due to
PAL-DS	Point (stacks), area (quarry) and line (vehicular) sources in short range
ISCST-3	Point and area sources in short range
CALINE 4	Vehicular sources close to road
RTDM3.2	Point and area sources existing at rough terrain in short range
VALLEY	Point and area sources existing in valley in short range
MESOPUFF	Point and area sources in long range
CDM	Point and area sources in short range
RAM	Point and area sources in short range
BLP	Point and line sources in short range
SDM	Point and area sources existing in coastal region in short range
CAL3QHC	Vehicular sources close to road for Hydrocarbon Levels
ADAM	Point and area sources in long range
ADMS-3	Point and area sources in long range
PANACHE	Meteorological data and point, area & line sources in any range
MTDDIS	Point and area sources in long range
TAPM	Meteorological data and impacts due to point, area and line sources in short and long range

Noise Environment:

Model	Used for Predicting Impacts due to
FHWA	Vehicular sources
Wave Divergence	Stationary sources

Aquatic Environment – Ground Water:

Model	Used for Predicting Impacts due to
GMS	Flow, direction, contaminant transport in saturated and unsaturated zones, subsurface solute transport with aerobic and sequential anaerobic bio-degeneration, remediation
FEMWATER/ LEWASTE	Stable contaminant transport & pollution, groundwater pollution and remediation
PATRIOT	Hydrology, stable contaminant transport & pollution and landuse management
PRZM3	Stable contaminant transport & pollution and landuse management, consequence of surface water pollution on groundwater
WhAEM2000	Risk of groundwater contamination, hydrology, stable contaminant transport & pollution

Aquatic Environment – Surface Water:

Model	Used for Predicting Impacts due to
MIKE 11	One dimensional model for dam break analysis, sediment transport, ecological and water quality assessments in rivers and wetlands
MIKE 21	Two dimensional model for Environmental Impact Assessment of marine infrastructure, sediment and mud transport, spill analysis
MIKE 3	Three dimensional model for various applications in different water bodies for water pollutions studies
MIKE SHE	Integrated surface and groundwater modeling
ECO LAB	For ecological modeling in rivers wetlands, lakes, reservoirs, estuaries, coastal waters and sea
CORMIX	Software for simulation for fluid-flow mixing in different water bodies
EXAMS	Aquatic Chemistry & Biology in streams and sea
GCSOLAR	Photolysis, half life
HSCTM2D	Hydrology, sediment & contaminant transport in river and estuary
HSPF	Aquatic chemistry and biology sediment transport and deposition in rivers
OXYREF	Dissolved oxygen, respiration, ventilation
PLUMES	Available dilution, design of marine outfall
PRZM3	Hydrology, metals and pesticides prediction in surface water
QUAL2EU	Water quality in stream, planning, non-point sources
SED3D	Hydrodynamics, sediment transport, 3-D, lakes, estuary, harbour, coastal
SMPTOX3	Toxic-chemicals in streams, aquatic biology, combined sewers
SWMM	Aquatic biology, combine sewers, community discharge, rivers, streams
TMDL USLE	Soil and sediment loss, watershed management
Visual Plumes	Surface water, contaminant transport
WASP	Hydrodynamics, aquatic biology, toxicant dispersal, hydrology

Surface Water Runoff:

Model	Used for Predicting Impacts due to
HEC-5	Flood hydrography, runoff estimation, catchment area treatment
HSPF	Hydrologic simulation in reservoir, nutrient growth
STORM	Urban watershed, storage/reservoir routing, sedimentation, erosion, reservoir chemistry

Ecology:

Model	Used for Predicting Impacts due to
ECOMOD	Estuary linked reservoirs, tidal action, saltwater intrusion, in-stream and in-reservoir dissolved oxygen primary and secondary productivity estimation
LAKE-I	Thermal stratification primary and secondary productivity

Food Chain:

Model	Used for Predicting Impacts due to
EGETS	Exposure levels and effects of contaminants on organisms which make food chain
LC50	Lethal concentration, LC50 toxicity levels

Multimedia:

Model	Useful for Predicting Impacts due to
3MRA	Multimedia pathway, receptor exposure, risk assessment
MINTEQA2	Aquatic biology, multimedia pathway
MMSOILS	Multimedia pathway, exposure assessment
MULTIMED (1.01)	Environmental effects of waste disposal in one media to another surface & ground water

Dam Break Analysis:

Model	Useful for Predicting Impacts due to
DAMBRK	Downstream flow simulation consequent to dam break

Risk Assessment:

Model	Useful for Predicting Impacts due to
SAFETI 6.21 & 6.42V	Complete package for consequence analysis and risk analysis in onshore process engineering
PHAST 6.21 V & 6.42V	Complete package for consequence analysis in onshore process engineering

12.1.9 Clients of CSIR-NEERI

12.1.9.1 Clients: International

- The World Bank
- Asian Development Bank
- United Nations Development Programme
- United Nations Environment Programme
- World Health Organization
- International Union of Conservation for Nature
- Danish International Development Agency
- Global Scan Technologies, Dubai
- Global Tech Safety & Environmental Consultancy, Dubai
- Dept. of Public Works and Highways (DPWH) / Environment and Social Services Office (ESSO), Philippines

12.1.9.2 Clients: Central Government

- Atomic Energy Regulatory Board
- Bharat Oman Refineries Limited
- Bharat Petroleum Corporation Limited
- Department of Science and Technology
- Gas Authority of India Limited
- Hindustan Organic Chemicals Limited
- Hindustan Petroleum Corporation Limited
- Indian Navy, Ministry of Defence
- Indian Oil Corporation Limited
- Indian Petrochemicals Corporation Limited
- Jawaharlal Nehru Port Trust
- Madras Refineries Limited
- Mangalore Refinery and Petrochemicals Limited

- Mumbai Port Trust
- National Aluminium Corporation Limited
- National Hydroelectric Power Corporation
- National Thermal Power Corporation Limited
- Nuclear Power Corporation India Limited
- Numaligarh Refineries Limited
- Oil India Limited
- Oil and Natural Gas Corporation Limited
- Rashtriya Chemicals & Fertilizers Limited
- Tuticorin Port Trust
- Western Coal Field

12.1.9.3 Clients: State Government

- Gujarat Industrial Development Corporation Limited
- Gujarat Narmada Valley Fertilizers Company Limited
- Gujarat State Petroleum Corporation Limited
- Gujarat State Petronet Limited
- Kudremukh Iron Ore Company Limited
- Maharashtra State Electricity Board
- Maharashtra Pollution Control Board
- Tamilnadu Industrial Development Corporation
- Chattisgarh State Electricity Board
- Narmada Water Resources, Water Supply & Kalpasar Deptt.
- Karnataka State Industrial Infrastructure Development Corporation Ltd.
- Steel Authority of India

12.1.9.4 Clients: Private Industries (National)

- ABG Cement
- Adani Ports and SEZ Limited
- Alembic Pharmaceuticals Ltd.
- Amanora Park Town
- Asian Paints India Ltd.
- Andhra Sugars
- Ballarpur Industries Ltd.
- Chhindwara Plus Developers Ltd.
- Cochin Port Trust
- Dighi Port Pvt. Ltd.
- Dony Polo Petrochemicals Ltd.
- Electrosteel Castings Ltd.
- ESSAR Oil Ltd.
- Grasim Industries Ltd.
- Green Environment Services Co-op. Soc. Ltd.
- Gujarat Pipavav Port Ltd.

- Gujarat Positra Port Infrastructure Ltd.
- Hazira Port Pvt. Ltd.
- Hindustan Oil Exploration Company Ltd.
- Hindustan Waste Treatment Pvt. Ltd., Goa
- Jindal Vijaynagar Steel Pvt. Ltd.
- Khemani Distilleries Pvt. Ltd.
- Lavasa Corporation Ltd.
- Nagarjuna Fertilizer and Chemicals
- NCTL Pvt. Ltd.
- Paradeep Phosphates Ltd.
- Paradip Port Trust
- Pipavav Ship Dismantling & Engineering Ltd.
- Reliance Petrochemical Ltd.
- Reliance Industries Ltd.
- Sahara India Pvt. Ltd.
- Saint-Gobain India Pvt. Ltd.
- Saurashtra Chemicals Ltd.
- Saurashtra Cement Limited, Gujarat
- Search Chem Industries Ltd.
- Tata Petrodyne
- United Phosphorus Ltd.
- Zuari Industries Ltd.

12.1.9.5 Clients: Private Industries (Multi-National)

- British Gas International (India)
- Cairn Energy India Pty. Limited
- Command Petroleum, Australia
- Enron Oil & Gas India Limited
- Hindustan Oil Exploration Company Limited
- Hindustan Oman Petroleum Company Limited
- Niko Resources Limited
- Petro Energy Products Company India Limited
- Rio Tinto Orissa Mining Limited
- Shell India Private Limited
- South Asia LPG Company Ltd., (a JV of M/s Total Gas & Power India)
- Mitsui & Company, Japan
- OAO Gazprom, Russia
- Mosbacher India L.L.C

12.1.10 Studies with International Funding

- Construction of Middle Vaitarna Dam for Augmentation of Water Resources and Irrigation near Mumbai (WB) (1990-1993)

- Augmentation of Chennai Water Supply – a Project at New Veeranam, Tamilnadu (WB) (1994-1995)
- Construction of Aerated Lagoons and Selection of Marine Outfall Location (Worli) off Mumbai Coast (WB) (1994-1995)
- Water Quality Studies for Hyderabad Water Supply and Sanitation Project (WB) (1995-1990)
- Oceanographic Modeling Studies for Sewage Outfall Location (Bandra) off Mumbai Coast (WB) (1995-1998)
- Strengthening EIA capacity and environmental legislation in India (ADP) (1998-2000)
- Implementation off Master Tourism Plan in Andaman Islands (UNDP) (1999-2000)
- Design & Implementation of Information Network for Indian Centre for Cleaner Technologies (WB) (1999-2002)
- Planning for Coastal and Marine Environment under Gujarat State Environmental Action Programme (WB) (1999-2000)
- Development of National Guidance Manual & Support Manual on EIA Practices for Enhancing the Quality & Effectiveness of Indian EIA's (WB) (2002-2004)
- Water needs of Brahmani & Sabrmati river basins (ICID) (2002-2004)
- Technical Assistance to ESSO to Enhance the Management of Social and Environmental Safeguards for DPWH Projects, Manila, Philippines (WB) (2005-2007)

12.1.11 US-AEP AWARD TO CSIR-NEERI

W13

UNITED STATES - ASIA ENVIRONMENTAL PARTNERSHIP

ENVIRONMENTAL LEADERSHIP AWARD

This award recognizes outstanding contributions made through working in partnership to improve the environment and quality of life for the people of Asia.

PRESENTED TO:

NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE

US-AEP

Winston Bowman
Regional Environmental Director
USAID Regional Development Mission/Asia

USAID | ASIA

Kris Easter
India Country Manager
US-Asia Environmental Partnership

US-AEP

Suneel Parasnis
India, Western Region Director
US-Asia Environmental Partnership

US-AEP

12.1.12 Conformity to ISO 9001:2008

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No: 30987-2008-AQ-IND-RvA | Initial certification date: 11, January, 2005 | Valid: 11, January, 2017 - 15, September, 2018

This is to certify that the management system of

CSIR-National Environmental Engineering Research Institute (NEERI)
Nehru Marg, Nagpur - 440 020, Maharashtra, India
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Quality Management System standard:
ISO 9001:2008

This certificate is valid for the following scope:
Design, develop and undertake R&D programmes for improvement in quality of environment through various activities leading to scientific and technological innovations, technical solutions, sharing knowledge & expertise for enabling government, industry and society

Place and date:
Chennai, 19, January, 2017

IAF MGMT. SYS. RvA C 024

The RvA is a signatory to the IAF MLA

For the issuing office:
DNV GL – Business Assurance
ROMA, No. 10, GST Road, Alandur, Chennai - 600 016, India

Sivadasan Madiyath
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
ACCREDITED UNIT: DNV GL Business Assurance B.V., ZWOLSEWEG 1, 3994 LB, BARENDRECHT, NETHERLANDS. TEL: +31102922689
assurance.dnvgl.com

12.1.13 NABET Accreditation

Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

National Environmental Engineering Research Institute
CSIR-NEERI, Nehru Marg, Nagpur 440020

Accredited as **Category - A** organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
2	River Valley projects	3	1 (c)	A
3	Thermal power plants	4	1 (d)	A
4	Petroleum refining industry	10	4 (a)	A
5	Chlor-alkali industry	13	4 (d)	B
6	Chemical fertilizers	16	5 (a)	B
7	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	18	5 (c)	A
8	Manmade fibers manufacturing	19	5 (d)	B
9	Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal	27	6 (a)	A
10	Industrial estates/ parks/ complexes/areas, export processing Zones(EPZs), Special Economic Zones(SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
11	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
12	Ports, harbours, break waters and dredging	33	7 (e)	A
13	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
14	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated Feb. 02, 2018 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/18/0592 dated March 15, 2018.The accreditation needs to be renewed before the expiry date by National Environmental Engineering Research Institute, Nagpur following due process of assessment

Sr. Director, NABET
Dated: Mar. 15, 2018

Certificate No.
NABET/ EIA/1720/ RA 0088

Valid till
17-02-2020

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

Validity Continuation Letter follows….

National Accreditation Board for Education and Training
(Member - International Accreditation Forum & Pacific Accreditation Cooperation)

QCI/NABET/ENV/ACO/19/1234 14 February 2020

CSIR- National Environmental Engineering Research Institute,
Nehru Marg, Nagpur- 440020, Maharashtra
(Kind Attention: Dr Rakesh Kumar)

Sub: Validity of Accreditation

Dear Sir,

This has reference to the accreditation of your organization under QCI-NABET EIA Scheme, the validity of **CSIR- National Environmental Engineering Research Institute,** is hereby extended till May 13, 2020 or completion of assessment process, whichever is earlier.

The above extension is subject to the submission of required information/documents related to assessment on time to NABET.

You are requested not to use this letter after expiry of the above stated date.

With best regards,

14/02/2020

A.K Jha
Senior Director| NABET

Institute of Town Planners India, 6th Floor, 4-A, Ring Road, I.P Estate, New Delhi-110 002, India
Tel. : +91-11-233 23 416, 417, 418, 419, 420, 421, 423 E-mail : ceo.nabet@qcin.org Website : www.qcin.org

12.1.14 Contact Persons

DIRECTOR	**:**	Dr. Rakesh Kumar
Phone	**:**	+91 712 2249999
Fax	**:**	+91 712 2249900
Email	**:**	director@neeri.res.in
NABET Coordinator	**:**	Dr. M. Suresh Kumar
Phone	**:**	+91 712 2247844
Fax	**:**	+91 712 2249896
GSM	**:**	+91 9422300590
Email	**:**	ms_kumar@neeri.res.in
EIA Coordinator	**:**	Dr. S.K. Goyal
Phone	**:**	+91 11 45609107
Fax	**:**	+91 11 4560916
GSM	**:**	+91 9423400470
Email	**:**	sk_goyal@neeri.res.in

Annexures

No.IA-J-11011/86/2020-IA-II(I)

Goverment of India

Minister of Enviroment,Forest and Climate Change

Impact Assessment Division

***

Indira Paryavaran Bhavan,
Vayu Wing,3rd Floor,Aliganj,
Jor Bagh Road,New Delhi-110003
18 Apr 2020

To,

M/s NAYARA ENERGY LIMITED
KHAMBHALIA, P.O.BOX.24,
Devbhumi Dwarka-361305
Gujarat

Tel.No.2833-662506; Email:priya.ayengar@nayaraenergy.com

Sir/Madam,

This has reference to the proposal submitted in the Ministry of Environment, Forest and Climate Change to prescribe the Terms of Reference (TOR) for undertaking detailed EIA study for the purpose of obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006. For this purpose, the proponent had submitted online information in the prescribed format (Form-1) along with a Pre-feasibility Report. The details of the proposal are given below:

1. Proposal No.:	IA/GJ/IND2/149284/2020
2. Name of the Proposal:	Asset Development Project-1 By Nayara Energy Limited at Vadinar, Devbhumi Dwarka, Gujarat
3. Category of the Proposal:	Industrial Projects - 2
4. Project/Activity applied for:	4(a) Petroleum refining industry 5(c) Petro-chemical complexes (industries based on processing of
5. Date of submission for TOR:	07 Apr 2020

In this regard, under the provisions of the EIA Notification 2006 as amended, the Standard TOR for the purpose of preparing environment impact assessment report and environment management plan for obtaining prior environment clearance is prescribed with public consultation as follows:

4(a):STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR PETROLEUM REFINING INDUSTRIESPROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

A. STANDARD TERMS OF REFERENCE

1) Executive Summary

2) Introduction

i. Details of the EIA Consultant including NABET accreditation

ii. Information about the project proponent

iii. Importance and benefits of the project

3) Project Description

i. Cost of project and time of completion.

ii. Products with capacities for the proposed project.

iii. If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.

iv. List of raw materials required and their source along with mode of transportation.

v. Other chemicals and materials required with quantities and storage capacities

vi. Details of Emission, effluents, hazardous waste generation and their management.

vii. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)

viii. Process description along with major equipments and machineries, process flow sheet (quantative) from raw material to products to be provided

ix. Hazard identification and details of proposed safety systems.

x. Expansion/modernization proposals:

a. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing Iexisting operation of the project from SPCB shall be attached with the EIA-EMP report.

b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification

2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.

4) Site Details

i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.

ii. A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places)

iii. Details w.r.t. option analysis for selection of site

iv. Co-ordinates (lat-long) of all four corners of the site.

v. Google map-Earth downloaded of the project site.

vi. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.

vii. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.

viii. Landuse break-up of total land of the project site (identified and acquired), government/ private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)

ix. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area

x. Geological features and Geo-hydrological status of the study area shall be included.

xi. Details of Drainage of the project upto 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects)

xii. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.

xiii. R&R details in respect of land in line with state Government policy.

5) Forest and wildlife related issues (if applicable):

i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable)

ii. Landuse map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland *(in case of projects involving forest land more than 40 ha)*

iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.

iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon

v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area

vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife

6) Environmental Status

i. Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.

ii. AAQ data (except monsoon) at 8 locations for PM10, PM2.5, SO2, NOX, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.

iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.

iv. Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.

v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC, if yes give details.

vi. Ground water monitoring at minimum at 8 locations shall be included.

vii. Noise levels monitoring at 8 locations within the study area.

viii. Soil Characteristic as per CPCB guidelines.

ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.

x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.

xi. Socio-economic status of the study area.

7) Impact and Environment Management Plan

i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.

ii. Water Quality modelling - in case of discharge in water body

iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.

iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.

v. Details of stack emission and action plan for control of emissions to meet standards.

vi. Measures for fugitive emission control

vii. Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.

viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.

ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.

x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.

xi. Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.

xii. Action plan for post-project environmental monitoring shall be submitted.

xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

8) Occupational health

i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers

ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.

iii. Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,

iv. Annual report of heath status of workers with special reference to Occupational Health and Safety.

9) Corporate Environment Policy

i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.

ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.

iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.

iv. Does the company have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report

10) Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.

11) Enterprise Social Commitment (ESC)

i. Adequate funds (at least 2.5 % of the project cost) shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon.

12) Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.

13) 'A tabular chart with index for point wise compliance of above TOR.

B. SPECIFIC TERMS OF REFERENCEFOREIASTUDIES FOR PETROLEUMREFININGINDUSTRY

1. Complete process flow diagram describing each unit, its capacity along-with material andenergy balance.
2. Details of intermediate product, their storages and final products to be manufactured.
3. Sulphur balance giving input from crude, refinery fuel (if used) and any other outside fuel and output in various products and emissions.
4. Details of proposed source-specific pollution controls chemes and equipment to meet thenational standards for petroleum refinery.
5. Details of emissions from all the stacks including volumetric flow rate.
6. Details on availability of rawmaterials (crude oil, naturalgas, chemicals, etc.), its source and storage at the plant.
7. Details on mode of transportationof crude and products.
8. Details of storage capacity of crude and products.
9. Ambient air quality data should include hydrocarbon (methane and non-methane), VOC, Ni & V etc.
10. Effortstominimize water consumption, effluent discharge and to maintain quality of receiving water body.
11. Details of effluent at men plant, inlet and treated water quality with specificefficiency of each treatment unit in reduction in respect of all con corned/ regulated environmental parameters. Also, include treatment details such as primary (physico-chemical), secondary (biological) and tertiary (activated carbon filters) treatment systems.
12. Storm water management plan.
13. Estimation SO2 and NOx emissions load.
14. Detailsonflaring system.
15. Details of VOCrecovery devices in the storage tanks.
16. Arrangement for spill management.
17. Oily sludge management plan.
18. Risk Assessment & Disaster Management Plan

i. Identification of hazards

ii. Consequence Analysis

iii. Risk assessment should also include leakages and location near to refinery & proposed measures for risk reduction.

iv. Arrangement for fire protection and control.

The following general points shall be noted:-

i. All documents shall be properly indexed, page numbered.

ii. Period/date of data collection shall be clearly indicated.

iii. Authenticated English translation of all material in Regional languages shall be provided.

iv. The letter/application for environmental clearance shall quote the MOEF file No. and also attach a copy of the letter.

v. The copy of the letter received from the Ministry shall be also attached as an annexure to the final EIA-EMP Report.

vi. The index of the final EIA-EMP report must indicate the specific chapter and page no. of the EIA-EMP Report

vii. While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MOEF vide O.M. No. J-11013/41/2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry shall also be followed.

viii. The consultants involved in the preparation of EIA-EMP report after accreditation with Quality Council of India (QCl) /National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA-EMP reports prepared by them and data provided by other organization/Laboratories including their status of approvals etc. Name of the Consultant and the Accreditation details shall be posted on the EIA-EMP Report as well as on the cover of the Hard Copy of the Presentation material for EC presentation.

ix. TOR' prescribed by the Expert Appraisal Committee (Industry) shall be considered for preparation of EIA-EMP report for the project in addition to all the relevant information as per the 'Generic Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006. Where the documents provided are in a language other than English, an English translation shall be provided. The draft EIA-EMP report shall be submitted to the State Pollution Control Board of the concerned State for conduct of Public Hearing. The SPCBshall conduct the Public Hearing/public consultation, district-wise, as per the provisions of EIA notification, 2006. The Public Hearing shall be chaired by an Officer not below the rank of Additional District Magistrate. The issues raised in the Public Hearing and during the consultation process and the commitments made by the project proponent on the same shall be included separately in EIA-EMP Report in a separate chapter and summarised in a tabular chart with financial budget (capital and revenue) along with time-schedule of implementation for complying with the commitments made. The final EIA report shall be submitted to the Ministry for obtaining environmental clearance.

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5(c): STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR PETRO-CHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TO AROMATICS)AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

A. STANDARD TERMS OF REFERENCE

1) Executive Summary

2) Introduction

i. Details of the EIA Consultant including NABET accreditation

ii. Information about the project proponent

iii. Importance and benefits of the project

3) Project Description

i. Cost of project and time of completion.

ii. Products with capacities for the proposed project.

iii. If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.

iv. List of raw materials required and their source along with mode of transportation.

v. Other chemicals and materials required with quantities and storage capacities

vi. Details of Emission, effluents, hazardous waste generation and their management.

vii. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)

viii. Process description along with major equipments and machineries, process flow sheet (quantative) from raw material to products to be provided

ix. Hazard identification and details of proposed safety systems.

x. Expansion/modernization proposals:

a. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing Iexisting operation of the project from SPCB shall be attached with the EIA-EMP report.

b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.

4) Site Details

i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.

ii. A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places)

iii. Details w.r.t. option analysis for selection of site

iv. Co-ordinates (lat-long) of all four corners of the site.

v. Google map-Earth downloaded of the project site.

vi. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.

vii. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.

viii. Landuse break-up of total land of the project site (identified and acquired), government/ private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)

ix. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area

x. Geological features and Geo-hydrological status of the study area shall be included.

xi. Details of Drainage of the project upto 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects)

xii. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.

xiii. R&R details in respect of land in line with state Government policy

5) Forest and wildlife related issues (if applicable):

i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable)

ii. Landuse map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland *(in case of projects involving forest land more than 40 ha)*

iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.

iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon

v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area

vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife.

6) Environmental Status

i. Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.

ii. AAQ data (except monsoon) at 8 locations for PM10, PM2.5, SO2, NOX, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.

iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.

iv. Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.

v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC, if yes give details.

vi. Ground water monitoring at minimum at 8 locations shall be included.

vii. Noise levels monitoring at 8 locations within the study area.

viii. Soil Characteristic as per CPCB guidelines.

ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.

x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-

I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.

xi. Socio-economic status of the study area.

7) Impact and Environment Management Plan

i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.

ii. Water Quality modelling - in case of discharge in water body

iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.

iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.

v. Details of stack emission and action plan for control of emissions to meet standards.

vi. Measures for fugitive emission control

vii. Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.

viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.

ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.

x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.

xi. Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.

xii. Action plan for post-project environmental monitoring shall be submitted.

xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

8) Occupational health

i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers

ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.

iii. Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,

iv. Annual report of heath status of workers with special reference to Occupational Health and Safety.

9) Corporate Environment Policy

i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.

ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.

iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.

iv. Does the company have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report

10) Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.

11) Enterprise Social Commitment (ESC)

i. Adequate funds (at least 2.5 % of the project cost) shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon.

12) Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.

13) 'A tabular chart with index for point wise compliance of above TOR.

B. SPECIFIC TERMS OF REFERENCE FOR EIASTUDIES FOR PETRO-CHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TO AROMATICS)

1. Detailsonrequirementof raw material (naphtha/gasfeedstock),itssource of supply and stor a geat the plant.
2. Complete process flow diagram for all products with material balance.
3. Brief description of equipments for various process (cracker, separation, polymerization etc)
4. Details of proposed source-specific pollution control schemes and equipments to meet the national standards.
5. Detailson VOC emission control system from vents, stacks, fugitive emissions and flare management, etc.
6. Details on proposed LDAR protocol.
7. Ambientair quality should include hydrocarbon (methane and non methane), VOC and VCM (if applicable).
8. Action plan to meet the standard prescribed under EPA for petrochemical complex.
9. Risk Assessment & Disaster Management Plan

? Identification of hazards

? Consequence Analysis

? Measures for mitigation of risk.

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Annexure 1.2

Compliance to Terms of Reference (ToR)

ToR Point No.	ToR Recommended by EAC	Compliance Status
Specific Conditions		
1. Executive Summary		
2. Introduction		
(i)	Details of the EIA Consultant including NABET accreditation	CSIR-NEERI is the EIA consultant. Details are given in **Chapter 12.**
(ii)	Information about the project proponent	**Chapter 1 (Page 1.1)**
(iii)	Importance and benefits of the project	**Chapter 1 (Page 1.3-1.4) & Chapter 8 (Page 8.1 - 8.4)**
3. Project Description		
i.	Cost of project and time of completion.	Details for project cost are given under **Chapter 2** at **Page 2.8.** Total cost is about Rs. 6200 Crores and time of completion is about 4 Years.
ii.	Products with capacities for the proposed project.	Products capacity details are given in **Chapter 2, Tables 2.2.1 & 2.3.1 (Page 2.10-2.11)**
iii.	Details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.	Details of existing products with capacities are given in **Chapter 2, Table 2.2.1 (Page 2.10).** Yes. Adequate land is available for this project, as the proposed project is going to be established in the existing premises. For earlier EC, please refer **Annexure 2.**
iv.	List of raw materials required and their source along with mode of transportation.	Details of raw materials required along with their sources are given under Section **2.4** of **Chapter 2 (Page 2.11-2.14).**
v.	Other chemicals and materials required with quantities and storage capacities	Details of other materials with their storage capacities are given in **Chapter 2, Tables 2.4.2, 2.4.3 & 2.4.4, (Page 2.14-2.19).**
vi.	Details of Emission, effluents, hazardous waste generation and their management.	Details of air emissions are given in **Chapter 4, section 4.3.1 (Page 4.11-4.15).** Details on effluents are given in **Section 4.3.3.2 (Page 4.20-4.21)**

		Details on hazardous waste management are given in **Section 4.3.4 (Page 4.29-4.32).**
Vii	Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)	Requirement of water and wastewater generation is given in **Section 2.5.2** and **Table 2.5.2 (Page 2.19-2.24);** Water balance diagrams are given in **Chapter 4, Section 4.3.3.3, Page 4.22-4.23**. Power requirement is given in **Chapter 2**, **Section 2.5.3** and **Table 2.5.3 (Page 2.22);** Man power requirement in **Section 2.5.11 (Page 2.26).**
Vii i.	Process description along with major equipment and machineries, process flow sheet (quantities) from raw material to products to be provided	Process description along with process flow diagrams (Page 2.2) are given in **Chapter 2, Section 2.2.1** (**Page 2.9- 2.13**) and **Annexure 3** (for Existing Refinery and Proposed ADP-1 project, respectively.
ix.	Hazard identification and details of proposed safety systems.	Details are covered in Risk Assessment Study Report as **Chapter 7**
x.	Expansion/modernization proposals:	
a.	Copy of all the Environmental Clearance(s) including Amendments there to obtain for the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing/existing operation of the project from SPCB shall be attached with the EIA-EMP report.	Details are given in **Chapter 1**, **Annexure 2**. Copy of 14 related letters attached. Status of existing Environment Clearance & CC&A are covered in EC compliance certification. Certified copy of compliance report is attached under **Annexure 7 (Volume 3)**.
b.	In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and	Not Applicable. Certified copy of compliance report is attached under **Annexure 7 (Volume 3)**.

	Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.	
4. Site Details		
i.	Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.	Site details are given in **Section 2.1.2 and Table 2.1.3** of **Chapter 2 (Page 2.3-2.7).**
ii.	A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (Including all eco-sensitive areas and environmentally sensitive places)	**Fig. 2.1.2** (A2 Copy of Toposheet is attached separately) **(Page 2.4).** Authenticated map from Chief Conservator of Forest for a distance of refinery from MNP/MNS attached as **Annexure 1.4.**
iii.	Details w.r.t. option analysis for selection of site	Not Applicable as the proposed expansion project is within the premises of existing refinery.
iv.	Co-ordinates (lat-long) of all four corners of the site.	Co-ordinate details are given in **Table 2.1.2 (Page 2.7) and Google map as Fig, 2.1.3 (Page 2.4)**
v.	Google map-Earth downloaded of the project site.	
vi.	Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.	Details are given in **Figs. 2.1.4 and 2.1.5 (Page 2.6-2.7).** A_0 sheet attached separately.
vii.	Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.	Photographs of Existing Refinery are shown in **Plate 2.1.1** and **Plate 2.1.2 (Page 2.8-2.9)**
viii.	Land use break-up of total land of the project site (identified and acquired), government/private -agricultural, forest, wasteland, water bodies, settlements, etc. shall be included. (Not required for industrial area)	Not applicable as the land is already under possession of the company.
ix.	A list of major industries with name and type within study area (10km radius)	Details of Major Industries within 10 km radius are given in **Table 2.1.3** of

	shall be incorporated. Land use details of the study area	Chapter 2 **(Page 2.7).**
x.	Geological features and Geo-hydrological status of the study area shall be included.	Details are given in **Chapter 3**, **Section 3.3.4** (**Page 3.28-3.29**).
xi.	Details of Drainage of the project up to 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (Mega green field projects)	Not Applicable
xii.	Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.	Not Applicable as ADP-1 project is proposed in the land available within refinery premises.
xiii.	R&R details in respect of land in line with state Government policy.	Not Applicable as the proposed project is within the premises of existing refinery.
5. Forest and wildlife related issues (if applicable)		
i.	Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (If applicable)	Not Applicable
ii.	Land use map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (in case of projects involving forest land more than 40 ha)	Not Applicable
iii.	Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.	Not Applicable
iv.	The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-a-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon.	Chief Wild life warden authenticated map showing distance of project site from MNP, MS, Forest is attached as **Annexure 1.4.**
v.	Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna	Schedule I category. Wildlife Conservation Plan duly authenticated by Chief Wildlife Warden is attached as **Annexure-1.4**

	, if any exists in the study area	
vi.	Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife	Not Applicable
6. Environmental Status		
i.	Determination of atmospheric inversion level at the project site and site-specific micrometeorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.	Meteorological data is presented in **Chapter 3, Section 3.1.4 (Page 3.3-3.6)**
ii.	AAQ data (except monsoon) at 8 locations for PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.	Air Quality data is presented in **Chapter 3, Section 3.1 (Pages 3.1-3.13). Table 3.1.3 to 3.1.4 (Page 3.11).**
iii.	Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAAQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.	Date and location wise raw data is given in **Annexure 4.**
iv.	Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.	Water Quality Characteristics in terms of physic-chemical, microbial and biological parameters of surface and ground water are given in **Chapter 3, Section 3.3, Pages 3.21-3.41**.
v.	Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC, if yes give details.	Not Applicable
vi.	Ground water monitoring at minimum 8 locations shall be included.	Water Quality Characteristics in terms of physic-chemical, microbial and biological parameters of surface and ground water are given in **Chapter 3, Section 3.3, Pages 3.21-3.41**.
vii.	Noise levels monitoring at 8 locations within the study area	Noise monitoring details are given in **Chapter 3, Section 3.2, Pages 3.14-3.20.**
viii.	Soil Characteristic as per CPCB guidelines.	Soil characteristics are given in **Section 3.4.1** of Land Environment in **Chapter 3 (Page 3.42-3.45).**

ix.	Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.	Traffic and Transportation details are given in **Section 4.3.1** of **Chapter 4 (Page 4.12-4.13).**
x.	Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.	Details of flora and fauna along with conservation plan are included in S**ection 3.5** under Biological Environment of **Chapter 3 (Pages 3.60-3.107)** and **Chapter 10, Section 10.2.5 (Pages 10.10-10.11).**
xi.	Socio-economic status of the study area.	Details are given under **Section 3.6** of Socio-economic Environment of **Chapter 3 (Pages 3.108-3.138).**
7. Impact and Environment Management Plan		
i.	Assessment of ground level concentration of pollutants from the stack emission based on site - specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.	Details are given in **Chapter 4** under **Section 4.3.1 (Pages 4.11-4.15).**
ii.	Water Quality modelling - in case of discharge in water body.	Discharged to deep sea as suggested by NIO. Marine monitoring report of NIO for 2017 is attached as **Annexure 7** (**Volume 3**).
iii.	Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.	No additional transport of Raw material required as throughput will remain same post project implementation. Product Truck details already covered in **Chapter-4**

iv.	A note on treatment of waste water from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.	Wastewater Treatment details are given in **Chapter 4, Section 4.3.3, Pages 4.20-4.28.**
v.	Details of stack emission and action plan for control of emissions to meet standards.	Details of Stack emission and control are given in **Chapter 4, Section 4.3.1, Pages 4.11-4.15).** Stack details are given in **Table 4.3.1.1 (Page 4.12)** for existing refinery
vi.	Measures for fugitive emission control.	
vii.	Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation,	Details of Hazardous Waste details are given in **Chapter 4 (Pages 4.29-4.33).** Copy of MOU is attached in **Annexure 7.**
viii.	Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided	Not applicable
ix.	Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall al so be incorporated.	Greenbelt area shall be 33% of total area of existing as well as proposed ADP-1 project. Please refer Chapter 4, Section 4.3.4, **(Page 4.29).**
x.	Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from	Action plan is provided in brief as a part of EMP in **Annexure 7.**
xi.	Total capital cost and recurring cost/ annum for environmental pollution control measures shall be included.	Details are given in **Chapter 10, Section 10.3**, (Pages **10.12**).

xii.	Action plan for post-project environmental monitoring shall be submitted.	Monitoring Program with future requirements are given in **Chapter 6, Section 6.1**, **Pages 6.1-6.3.**
xiii.	Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and dam age control. Disaster management plan should be linked with District Disaster	Details are included in Risk Assessment Report (**Chapter 7)**.
8. Occupational health		
i.	Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers	Details for existing refinery are given in **Annexure 7**. Similar, provision shall be made for expansion project also.
ii.	Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, color vision and any other ocular defect) ECG, during pre- placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure	Details of exposure specific health status for existing refinery are given in **Annexure 7.** Similar practice shall be adopted for ADP-1 project also.
iii.	Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved.	Details for existing refinery are given in **Annexure 7**. Similar practices shall be followed for ADP-1 project also.
iv.	Annual report of health status of workers with special reference to Occupational Health and Safety.	Details for existing refinery are given in **Annexure 7**. Similar practices shall be followed for ADP-1 project also.
9. Corporate Environment Policy		
i.	Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	Yes, Copy Attached.

ii.	Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms 1 conditions? If so, it may be detailed in the EIA.	Yes, refinery has implemented our own Refinery Integrated Management Systems (RIMS) comprising of ISO 9001 (Quality), ISO 14001 (Environment), ISO 45001(Occupational Health & Safety) & ISO 50001. As per ISO certification process are followed. ISO certificates are attached in **Annexure 7.**
iii.	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.	Details are given in **Chapter 6**, **Section 6.2**, **Pages 6.4-6.5**.
iv.	Does the company have system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report	Yes, Details are given in **Chapter 6**, **Section 6.2**.
10.	Details regarding infrastructure facilities such as sanitation, fuel, rest room etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.	Restrooms as well as cafeteria for all the truck drivers are available in the existing refinery. Washrooms have been provided at all the strategic locations as per the legal requirement. Similar ADP-1project also.

11.	Enterprise Social Commitment (ESC) adequate funds shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon.	Company will earmark fund of the project cost towards the CER as per Office Memorandum of MoEFCC, New Delhi dated May 1, 2018. Please refer Cahpter-10 page no.10.13 and 10.14 for CER plan. __ Humble request to exempt Public Hearing to this project as per Para No. 7 (ii) (a) of the EIA Notification, 2006 & Amendment Notification dated Nov. 23, 2016 (as given below). "All applications seeking prior environmental clearance for expansion with increase in the production capacity beyond the capacity for which prior environmental clearance has been granted under this notification or with increase in either lease area or production capacity in the case of mining projects or for the modernization of an existing unit with increase in the total production capacity beyond the threshold limit prescribed in the Schedule to this notification through change in process and or technology or involving a change in the product –mix shall be made in Form I and they shall be considered by the concerned Expert Appraisal Committee or State Level Expert Appraisal Committee within sixty days, who will decide on the due diligence necessary including preparation of EIA and public consultations and the application shall be appraised accordingly for grant of environmental clearance

12.	Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance to the notice(s) and present status of the case.	No litigation pending against the project. No Notice of litigation received by company with respect to expansion project. Yes High Courts, Gujarat SCA 15322/2019 No stay was granted. Few procedural orders were passed. Notice issued by CPCB under Section -5 of Environment (Protection) Act , 1986 and same has been revoked also for the existing refinery. GPCB has issued a notice under section 31(A) of Air act is also attached for your reference, and the company has submitted response to the notice. Copy of above letters is attached as **Annexure 1.**

B. SPECIFIC TERMS OF REFERENCE FOR EIA STUDIES FOR PETROLEUM REFINING INDUSTRY

ToR Point No.	ToR Recommended by EAC	Compliance Status
1	Complete process flow diagram describing each unit, its capacity along-with material and energy balance.	The process flow chart is given as **Annexure 3**. The process details are given in **section 2.2 of Chapter 2 (Pages 2.9-2.14)**
2	Details of intermediate product, their storages and final products to be manufactured.	Details of intermediate products, their storages and final products is given in **Section:2.4.3 of Chapter 2, (Page No. 2.14-2.19)**
3	Sulphur balance giving input from crude, refinery fuel (if used) and any other outside fuel and output in various products and emissions.	Sulphur Balance is given in **Section 2.6.1 of Chapter 2 (Page 2.27)**: Fuel Details are given in **Section 2.5.9: Page No.:2.25.**
4	Details of proposed source-specific pollution control schemes and equipment to meet the national standards for petroleum refinery.	Details of proposed source-specific pollution control schemes are given in **Section: 2.6 of Chapter 2, (Page No.:2.26-2.27)**
5	Details of emissions from all the stacks including volumetric flow rate.	Details of emissions from all the stacks including volumetric flow rate is given in **Table 4.3.3.1 of Chapter 4 (Page No.:4.12)**
6	Details on availability of raw materials (crude oil, natural gas, chemicals, etc.), its source and storage at the plant.	No additional raw material requirement. Throughput of the refinery will remain same. Raw material details of existing refinery is given in **Table 2.4.2 of Chapter 2: (Page No.:2.15)**
7	Details on mode of transportation of crude and products.	Details on mode of Transportation of crude and products is given in **Section:2.4 of Chapter 2.11, (Page No.:2.11-2.14)**
8	Details of storage capacity of crude and products.	Details on storage capacity of crude and products are given in **Section 2.4.3: (Page No.:2.14 -2.19)**
9	Ambient air quality data should include hydrocarbon (methane and non-methane), VOC, Ni & V etc.	Air Quality data is presented in **Chapter 3, Section 3.1 (Pages 3.1-3.13). Table 3.1.3 to 3.1.4 (Page**

		3.11).
10	Efforts to minimize water consumption, effluent discharge and to maintain quality of receiving water body.	Requirement of water and wastewater generation is given in **Section 2.5.2** and **Table 2.5.2 (Page 2.20-2.23);** Water balance diagrams are given in **Chapter 4, Section 4.3.3.3, Page 4.22-4.23**.
11	Details of effluent at men plant, inlet and treated water quality with specific efficiency of each treatment unit in reduction in respect of all concerned/ regulated environmental parameters. Also, include treatment details such as primary (physico-chemical), secondary (biological) and tertiary (activated carbon filters) treatment systems.	Details of Effluent Treatment plant is given in **Section: 4.3.3.4 of Chapter 4. (Page No.:4.25 - 4.28)**
12	Storm water management plan.	Storm water drains have been provided at all the required locations in the Refinery with pacca flooring. Oil catchers have been constructed at strategic locations of the storm water channel to avoid any slippage of oil during heavy rains Rain water harvesting pond has been made as well as ground water recharges is being carried out within refiniery. Further details are given in brief as part of EMP in **Annexure -7** (Certified Compliance Report)
13	Estimation SO2 and NOx emissions load.	***There will be no emissions of SO_2, NO_2 or PM from the Polypropylene Plant on daily basis.***
14	Details on flaring system.	**BASE REFINERY FLARE SYSTEM:** Flare are an integral part of the safety system intended to prevent the risks of explosive, accumulation of flammable, deleterious, toxic and polluting gases in the atmosphere. A flare system is designed to dispose off the specified gas stream safely and efficiently by flaring. Base refinery involves three flares as described below: 1) Hydrocarbon (HC) Flare

		2) H2S Flare 3) LPG flare(Dedicated to LPG spheres) The Flaring system are elevated & provided with Derrick supporting structure (one common for HC & H2S flare). The HC flare steam assisted smokeless type whereas the H2S flare is non-smokeless type. The flare system components are sized for design flare load, so that specific condition of velocity, combustion & Air entrainment are met which in turn ensure flammability and flame stability. To maintain a constant source of ignition at all times & under all operating conditions, the steam assisted smokeless HC flare tip is provided with four pilot burners, the non-smokeless H2S flare Tip is fitted with tow pilot burners. Both the tips are provided with flame retention lugs to provide flame stability at high flare gas discharge rates. The HC Flares molecular seal are located just below the flare tip. The H2S flare tip is provided with Integral velocity type seal which is located integrally at the bottom of flare tip. The seals have been designed to prevent air ingress into the flare risers thus preventing the formation of an explosion mixture in the systems. A small continuous bleed of purge gas at specified flow is maintained in order to ensure that the air does not penetrate in the seal & below. **<u>TRAIN-1 FLARE SYSTEM:</u>** It was decided by Nayar to implement 2 Flare systems for handling the maximum relief load from Train-I facility. The 2 flare systems consist of Low Pressure (LP), and Acid Gas flare with separate flare stacks and associated facilities. LP Flare System: All LP relief sources from Train-I and Train– II units with Set Pr. Less than 10.5 Kg/cm2 (g) to be routed to a common LP flare system. Maximum back pressure at the unit battery limit based on the design/peak flare load is considered as 1.1 Kg/cm2 (g). Acid Gas Flare System: All relief sources from Train-I and Train – II units containing H2S to be routed to a common Acid Gas flare system. Maximum back pressure at the unit battery limit based on the

		design/peak flare load is considered as 1.1 Kg/cm2 (g).
15	Details of VOC recovery devices in the storage tanks.	Floating roof double seal tanks have been provided to reduce the VOC fugitives' emission for all Class-A & B Hydrocarbons (HC). Leak Detection and Repair Program (LDAR) has been implemented in the refinery. The program includes leak detection of valves, flanges, pumps, rim seals, rim vents, floating & fixed roof top of storage tanks etc.
16	Arrangement for spill management.	Arrangement for spill managements are given in **Section 10.2.4 of Chapter 10. (Page 10.9)**
17	Oily sludge management plan.	Oily sludge management plan is given in **Section 10.2.4 of Chapter 10. (Page 10.9)**
18	Risk Assessment & Disaster Management Plan	Risk assessment and Disaster management Plan is covered in **Chapter 7**
i	Identification of hazards	Hazardous Waste Management from Existing Refinery and Proposed ADP-1 is described in **Section 4.3.4 of Chapter 4 (Page 4.29-4.32).** Existing hazardous waste management facilities are sufficient to handle the additional waste from ADP-1. Further, Hazardous Waste Management Rules, 2016, stipulated by MoEF&CC shall be followed, along with any rules/ guidelines prepared by the State Govt. in this regard.
ii	Consequence Analysis	Consequence Analysis is given in **Chapter 7**
iii	Risk assessment should also include leakages and location near to refinery & proposed measures for risk reduction.	Risk assessment details are covered in **Chapter 7**
iv	Arrangement for fire protection and control.	Arrangements on fire protection and control is given in **Section:2.5.10 of Chapter 2 (Page No.:2.25-2.26)**

B. SPECIFIC TERMS OF REFERENCE FOR EIASTUDIES FOR PETRO-CHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TO AROMATICS)

ToR Point No.	ToR Recommended by EAC	Compliance Status
1	Details on requirement of raw material (naphtha/gas feedstock), it's source of supply and storage at the plant.	Details of raw materials required for existing refinery along with their sources are given under Section **2.4.3** of **Chapter 2 (Page 2.14-2.19). For ADP-1 project no additional raw material required.**
2	Complete process flow diagram for all products with material balance.	The process flow chart is given as **Annexure 3**. The process details are given in **section 2.2 of Chapter 2 (Pages 2.9-2.14)**
3	Brief description of equipment for various process (cracker, separation, polymerization etc)	Details are given in **Section 2.3 of Chapter 2 (Page No. 2.10-2.11)**
4	Details of proposed source-specific pollution control schemes and equipments to meet the national standards.	Details of proposed source-specific pollution control schemes are given in **Section: 2.6 of Chapter 2, (Page No.:2.26-2.27)**
5	Details on VOC emission control system from vents, stacks, fugitive emissions and flare management, etc.	Details on VOC emission control system from vents, stack, fugitive emissions and flare management is given in **Chapter 2, (Page No.:2.26-2.27)**
6	Details on proposed LDAR protocol.	Existing plant is having its own LDAR program based MoEF Notification 18.03.2008, additional units will be incorporated in same.
7	Ambient air quality should include hydrocarbon (methane and non-methane), VOC and VCM (if applicable).	Air Quality data is presented in **Chapter 3, Section 3.1 (Pages 3.1- 3.13). Table 3.1.3 to 3.1.4 (Page 3.11).**

8	Action plan to meet the standard prescribed under EPA for petrochemical complex.	Details on storage capacity of crude and products are given in **Section 2.4.3: (Page No.:2.14 -2.19). Please refer Chapter 2, (Page No.:2.26-2.27)**
9	Risk Assessment & Disaster Management Plan	Risk assessment and Disaster management Plan is covered in **Chapter 7**
i	Identification of hazards	Hazardous Waste Management from Existing Refinery and Proposed ADP-1 is described in **Section 4.3.4 of Chapter 4 (Page 4.29-4.32).** Existing hazardous waste management facilities are sufficient to handle the additional waste from ADP-1. Further, Solid and Hazardous Waste Management Rules, 2016, stipulated by MoEF&CC shall be followed, along with any rules/ guidelines prepared by the State Govt. in this regard.
ii	Consequence Analysis	Consequence Analysis is given in **Chapter 7**
iii	Risk assessment should also include leakages and location near to refinery & proposed measures for risk reduction.	Risk assessment details are covered in **Chapter 7**
iv	Arrangement for fire protection and control.	Arrangements on fire protection and control is given in **Section:2.5.10 of Chapter 2 (Page No.:2.25-2.26)**

No. WLP/32/C/ 1019-20 /2019-20
Office of the Principal Conservator of Forests (Wildlife)
B/1 Aranya Bhavan, B-Block, 1st Floor, Sector – 10/A,
Gujarat State, Gandhinagar
Date: -19/02/2020

To,
M/s Nayara Energy Limited,
Khambhalia, Post, PO Box No. 24,
District:- Devbhumi Dwarka (Gujarat)

Sub: - Expansion of Refinery from 20 MMTPA to 46 MMTPA and Petrochemical Complex at Khambhalia, District Devbhumi Dwarka (Gujarat) by M/s Nayara Energy Limited – Terms of Reference – reg.

Ref: - MoEF & CC, IA Division, Govt. of India's letter no. F.No. J-11011/320/2006-IA-II(I), dated. 03/08/2018

With reference to the subject and letter quoted above, the Wildlife Conservation Plan for Expansion of Refinery from 20 MMTPA to 46 MMTPA and Petrochemical Complex at Khambhalia, District Devbhumi Dwarka (Gujarat) by M/s Nayara Energy Limited in a total area of 2275 ha. prepared by CSIR – National Environmental Engineering Research Institute (NEERI), New Delhi. The Wildlife Conservation Plan of **Rs. 40.00** lakhs as per annexure – A has been approved. A copy of the Wildlife Conservation Plan and authorized map is enclosed herewith.

Encl. As above

(Shyamal Tikadar)
Chief Wildlife Warden
Gujarat State, Gandinagar

Copy to:- Chief Conservator Forests, Marine National Park, Jamnagar vide their letter no. A/LND/24/T.7/1075-76, dated. 08.01.2020 for information and necessary action.

Annexure-1

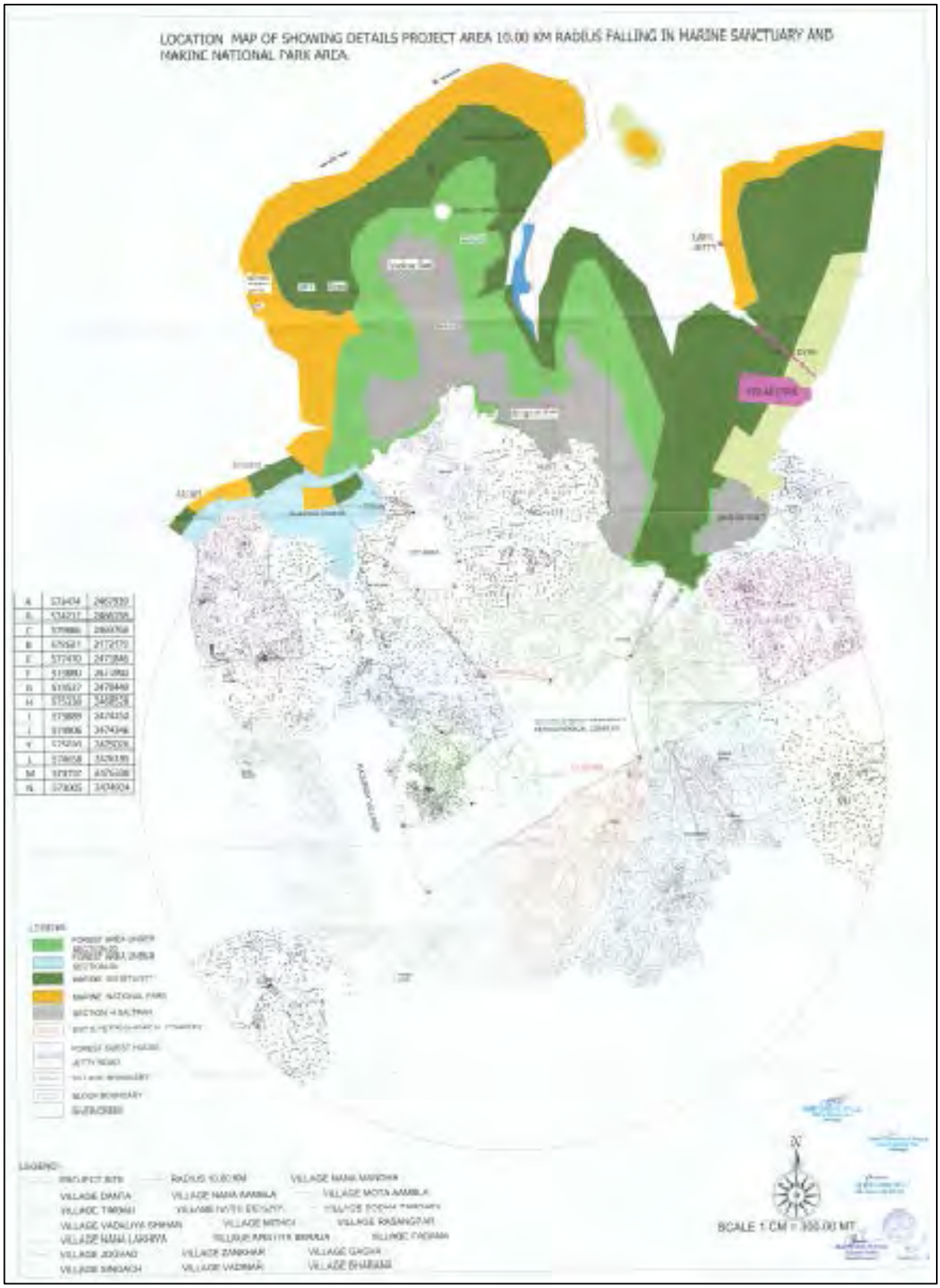
Tentative Budgetary plan for 10 years

Sr. No.	Particulars for conservation	Cost (in lakh Rupees)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1	Conducting awareness programmes during "Wildlife Week" and "Van Mahotsav" (community and school level).	6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
2	Informers reward programme for the control of poaching and illegal trade in wildlife.	3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
3	Water requirement during summer and maintenance of existing water bodies.	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
4	Increase tree cover in the buffer area for shelter and roosting of peacocks.	4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
5	Provisions of veterinary care and cages for injured or sick deformed birds	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
6	Promote conservation of peacock habitats and population	10	1	1	1	1	1	1	1	1	1	1
7	Miscellaneous projects	7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total Budget		**40**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**

Chief Wildlife Warden
Gujarat State
Gandhinagar

Annexure 1.4:

Chief Wild life warden authenticated map showing distance of project site from MNP, MS, Forest



केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE GOVT. OF INDIA

BY REGISTERED AD

June 06, 2018

B-29016/04/06/IPC-I/

To,

Sh. Prabhanjan Dixit, VP (EHS)
M/s Essar Oil Ltd,
Jamnagar-Okh Highway,
Vadinar Vill., Dist. Dwarka,
Gujarat – 361305

Sub: Directions under Section 5 of the Environment (Protection) Act, 1986 – notice thereof.

WHEREAS, the Oil Refineries industries are identified as one of the 17 categories of highly polluting industries which have been discharging environmental pollutants directly or indirectly into the ambient air and water, having potential threat to cause adverse effect on the water and air quality; and

WHEREAS, Unit has provided the connectivity of the online monitoring system of Stacks and for Effluent data to the CPCB as per detail registered by the unit on Aug 6, 2015; and

WHEREAS, Unit has shortlisted for inspection based on the SMS alerts received during 15 Feb- 15 March, 2018; and

WHEREAS, Central Pollution Control Board, Regional Directorate, Vadodara inspected the unit on May 02, 2018 and observed the following:

1. In FCC-R unit the measured CO value was BDL, but the OCEMS value was 320.37.mg/Nm3, the value is within the GPCB prescribed limit of 400mg/Nm3.
2. In DCU -1 & 3 the measured CO value was BDL, but the OCEMS values in DCU-H1 576.65mg/Nm3, DCU-H3 240.27mg/Nm3 are exceeding the GPCB prescribed limit of 150 mg/Nm3
3. The unit has not provided OCEMS for the measurement of PM and SO_x in the stacks attached to SRU unit as per inspection report and CPCB, IT division report dated May 28, 2018
4. The unit has not installed online PM analysers in 13 Stacks out of 17 stacks except stack attached to CDU, VDU and FCCR unit as per IT division report dated May 28, 2018

WHEREAS, the unit has not installed online PM analysers in 13 Stacks , which is non-compliance of the direction issued by CPCB under section 5 of the E(P) Act, 1986 and action as per law shall be initiated separately and environmental compensation charges will be imposed till the compliance is achieved; and

'परिवेश भवन' पूर्वी अर्जुन नगर, दिल्ली-110032
Parivesh Bhawan, East Arjun Nagar, Delhi-110032
दूरभाष/Tel : 43102030, 22305792, वेबसाईट/Website : www.cpcb.nic.in

WHEREAS, the Ministry of Environment & Forests, Government of India, vide Notifications No. S. O. 157 (E) of 27.02.1996 and S. O. 730 (E) dated 10.07.2002, has delegated the powers vested under Section 5 of the Environment (Protection) Act, 1986 (29 of 1986) to the Chairman, Central Pollution Control Board, to issue directions to any industry or any local body or any other authority for violations of the standards and rules notified under the Environment (Protection) Rules, 1986 and amendment thereof.

NOW THEREORE, in view of the above and in exercise of powers delegated to the Chairman, Central Pollution Control Board, under Section 5 of the Environment (Protection) Act, 1986 notice is hereby served to the unit to show cause that why the unit shall not be directed to close down all manufacturing / production activities until comply with the following directions:

1. The unit shall take appropriate measures and calibrate the OCEMS system to reflect the correct value of CO emissions in the stacks attached to FCCR, DCU- 1 & DCU-3.

2. The unit shall provide the OCEMS analyser in all stacks for the measurement of SO_x, NOx, PM and CO.

The compliance of above directions shall be submitted to this office within 15 days of the receipt of this direction. In case of failure to comply with the said direction necessary action as deemed fit under the provision of Environment (Protection) Act, 1986 will be taken by Central Pollution Control Board.

(S.P.Singh Parihar)
Chairman

08/06/18

Annexure
Rcd on 8.02.19

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE GOVT. OF INDIA

BY REGISTERED AD

B-29016/04/06/IPC-I/ 15982

January 29, 2019

To,

Sh. Prabhanjan Dixit, VP (EHS)
M/s Nayara Energy Limited (Formerly Essar Oil Ltd),
Jamnagar-Okh Highway,
Vadinar Vill., Dist. Dwarka,
Gujarat - 361305

Sub: Directions under Section 5 of the Environment (Protection) Act, 1986 - reg.

WHEREAS, the Oil Refineries industries are identified as one of the 17 categories of highly polluting industries which have been discharging environmental pollutants directly or indirectly into the ambient air and water, having potential threat to cause adverse effect on the water and air quality; and

WHEREAS, Unit has provided the connectivity of the online monitoring system of Stacks and for Effluent data to the CPCB as per detail registered by the unit on Aug 6, 2015; and

WHEREAS, Unit has shortlisted for inspection based on the SMS alerts received during 15 Feb- 15 March, 2018; and

WHEREAS, Central Pollution Control Board, Regional Directorate, Vadodara inspected the unit on May 02, 2018 and observed the following:

1. In FCC-R unit the measured CO value was BDL, but the OCEMS value was 320.37.mg/Nm3, the value is within the GPCB prescribed limit of 400mg/Nm3.
2. In DCU -1 & 3 the measured CO value was BDL, but the OCEMS values in DCU-H1 576.65mg/Nm3, DCU-H3 240.27mg/Nm3 are exceeding the GPCB prescribed limit of 150 mg/Nm3
3. The unit has not provided OCEMS for the measurement of PM and SO_x in the stacks attached to SRU unit as per inspection report and CPCB, IT division report dated May 28, 2018
4. The unit has not installed online PM analysers in 13 Stacks out of 17 stacks except stack attached to CDU, VDU and FCCR unit as per IT division report dated May 28, 2018

WHEREAS, based on above stated observations, Directions (notice) under section 5 of the Environment (Protection) Act, 1986, was issued to **M/s Nayara Energy Limited (Formerly Essar Oil Ltd)**, on June 06, 2018 to show cause as to why your unit not be directed to close down all operational activities with immediate effect until following directions are compiled:

1. The unit shall take appropriate measures and calibrate the OCEMS system to reflect the correct value of CO emissions in the stacks attached to FCCR, DCU- 1 & DCU-3 unit so as to meet the GPCB prescribed norms.
2. The unit shall provide the OCEMS analyser in all stacks for the measurement of SO_x, NOx, PM and CO.

WHEREAS, unit has submitted the reply to the Directions (Notice), vide letter dated June 15, 2018; and

WHEREAS, unit has informed that they will complete the process w.r.t installation of PM analyzers in remaining stacks by December 31, 2018 and these 10 units have not taken any shut down since 2015 and planned for shut down of these units in December, 2018 as per e-mail dated October 13, 2018; and

WHEREAS, The Hon'ble National Green Tribunal (NGT), Principal Bench in the matter of OA No. 593/2017 (WP (CIVIL) No. 375/2012, Paryavaran Suraksha Samiti & Anr. Vs. Union of India & Ors. directed Central Pollution Control Board (CPCB) to take penal action for failure, if any, against those accountable for setting up and maintaining STPs, CETPs and ETPs and CPCB may also assess and recover compensation for damage to the environment and said fund may be kept in a separate account and utilized in terms of an action plan for protection of the environment; and

WHEREAS, direction for environmental compensation issued to the Unit dated December 26, 2018 to deposit Rs 61,20,000/- for the non-compliance period (June 06,2018 to December 26,2018) in CPCB A/c No. 532702050000164 (Bank name: Union Bank of India, IP Extension Branch, Vikas Marg Extn., Delhi; IFSC: UBIN0553271); and

WHEREAS, Unit informed through letter dated Jan 18, 2019 that unit has deposited the environmental compensation charge of Rs. 61, 20, 000 vide UTR No. SBINR12019011800087943; and

WHEREAS, Unit has calibrated the OCEMS system on June 08, 2018 to reflect the correct value of CO emissions in the stacks attached to FCCR, DCU- 1 & DCU-3 and Calibration of each analyzer is conducted on quarterly basis as per schedule; and

WHEREAS, Unit has installed PM analyzer in pending 10 Stacks where it was necessary requirement and provided connectivity as per CPCB IT Division report dated Jan 14, 2019; and

WHEREAS, the Ministry of Environment & Forests, Government of India, vide Notifications No. S. O. 157 (E) of 27.02.1996 and S. O. 730 (E) dated 10.07.2002, has delegated the powers vested under Section 5 of the Environment (Protection) Act, 1986 (29 of 1986) to the Chairman, Central Pollution Control Board, to issue directions to any industry or any local body or any other authority for violations of the standards and rules notified under the Environment (Protection) Rules, 1986 and amendment thereof.

NOW, THEREFORE, in view of the above and in exercise of powers delegated to the Chairman, Central Pollution Control Board under Section 5 of the Environment (Protection) Act, 1986, show cause notice issued to **M/s Nayara Energy Limited (Formerly Essar Oil Ltd)**, vide letter dated June 06, 2018, is hereby revoked with following condition:

1. Unit shall ensure uninterrupted connectivity with CPCB server.

In case of non-compliance by the Unit action as deemed fit under the provisions of Environment (P) Act, 1986 shall be taken.

(S.P.Singh Parihar)
Chairman
31.01.19

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, Gandhinagar 382 010
Phone : (079) 23222425
(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

By RPAD

હવા પ્રદૂષણ (નિવારણ અને નિયંત્રણ) અધિનિયમ ૧૯૮૧ની કલમ ૩૧(અ) હેઠળ ઉદ્યોગને સૂચના (નોટીસ)

1) આપ મે.નાયરા એનર્જી લી. પ્લોટ નં. એસ.નં.૬૨-૬૬ જામનગર-ઓખા હાઈવે(એસ-૨૫),પો.બોક્સ નં.૨૪, ગામ: વાડીનાર-૩૬૧૩૦૫, તા. ખંભાલીયા, જી.દેવભૂમિ દ્વારકા ખાતે ઉદ્યોગ ચલાવો છો. અને પેટ્રોલીયમ પ્રોડકટનું ઉત્પાદન કરો છો.

2) આપને જણાવવાનું કે આપના ઉદ્યોગની સ્થળ મુલાકાત તા.૦૨/૦૮/૨૦૧૯ના રોજ બોર્ડના અધિકારીઓએ લીધેલ ત્યારે એકમ કાર્યરત જોવા મળેલ અને નીચે મુજબની ક્ષતિઓ જોવા જાણવા મળેલ.

- આપના એકમની સ્થળ તપાસ દરમ્યાન સલ્ફર સ્ટોરેજ સાયલો માંથી ટ્રકમાં લોડીંગ કરતી વખતે હેવી ડસ્ટીંગ થતું જોવા મળેલ.
- આપના એકમના ઈટીપી માથી લીધેલ ગંદાપાણીના નમૂનાના પૃથ્થકરણ અહેવાલ જોતા નીચે મુજબના પરીમાણો નિયત્રમાત્રા કરતા વધારે જણાયેલ.
  S.S- 26 mg/l.
- સ્થળતપાસ દરમ્યાન CDU-1માથે જોડેલ ચીમનીમાંથી Stack Sampling કરતા PM-162 mg/nm^3 જણાયેલ તથા FCC Regeneration માથે જોડાયેલ ચીમનીમાંથી કરેલ Stack Sampling કરતા PM-183 mg/nm^3 જણાયેલ જે નિયત ધોરણ કરતાં વધારે છે.

હુકમ

ઉપરોકત સંજોગોમાં હું (જી.એચ.ત્રિવેદી, વરિષ્ઠ પર્યાવરણ ઇજનેર) ગુજરાત પ્રદૂષણ નિયંત્રણ બોર્ડ, હવા અધિનિયમની કલમ -૩૧ (અ) હેઠળ નીચે મુજબ સૂચના આપુ છું કે

૧) આપના ઉદ્યોગની ઉત્પાદન પ્રકિયા બંધ કરવા હવા અધિનિયમ-૧૯૮૧ની કલમ-31(અ) હેઠળ શા માટે આદેશ ન આપવા?

૨) જો આપની ઉત્પાદન પ્રકિયા આપના પોતાના (કેપ્ટીવ) પાવર પ્લાન્ટ કે ડી.જી. સેટથી ચાલતી હોય તો તે પણ બંધ કરાવવા ઉપરોકત હવા અધિનિયમ-૧૯૮૧ની કલમ-31 (અ) હેઠળ શા માટે સીલ અને બંધ કરવાના આદેશ ન આપવા ?

૩) આપના ઉદ્યોગને મળતો વીજ પુરવઠો અને પાણી પુરવઠો કાપી નાખવાના ઉપરોકત હવા અધિનિયમ-૧૯૮૧ની કલમ-૩૧ (અ) હેઠળ શા માટે આદેશ ન આપવા ?

જો આપ દિન-15માં આપની લેખિતમા રજૂઆત કરવામાં કે ખુલાસો કરવામાં નિષ્ફળ જશો તો આપને આ બાબતે રજુઆત કરવાની રહેતી નથી તેમ માનીને બોર્ડને હવા અધિનિયમ ૧૯૮૧ની કલમ-૩૧ (અ) હેઠળ ઉપર મુજબનો આદેશ આપવાની ફરજ પડશે અને તે બાદની સમગ્ર જવાબદારી આપની રહેશે જેની નોંધ લેશો.

ગુજરાત પ્રદૂષણ નિયંત્રણ બોર્ડના નામે અને વતી,

(જી.એચ.ત્રિવેદી)
વરિષ્ઠ પર્યાવરણ ઇજનેર

નંબર :જી.પી.સી.બો/સી.સી.એ-જે.એમ.એન-૩૬૬(૨૦/૧૧)- ૨૬૩૯૮/ 519683 તા. 5/9/19

પ્રતિ,
મે. નાયરા એનર્જી લી.,
પ્લોટ નં. સર્વે.નં.૬૨-૬૬,
જામનગર-ઓખા હાઈવે (એસ.એચ. -૨૫), પો.બોક્સ નં.૨૪,
ગામ: વાડીનાર -૩૬૧૩૦૫,
તા. ખંભાલીયા, જી.દેવભૂમિ દ્વારકા.

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GUJARAT POLLUTION CONTROL BOARD

Paryavaran Bhavan, Sector No. 10-A, Gandhinagar-382 010.

વિકાસની પ્રગતિ જાળવી રાખવા શિસ્તબદ્ધ થઈને પ્રદૂષણ નિયંત્રણ અપનાવીએ.

Reference No. Nayara Energy/27398/ENV/GPCB/2019/876
20th September, 2019

NAYARA ENERGY

To,
Shri G.H. Trivedi
Senior Environment Engineer
Gujarat Pollution Control Board (GPCB)
Paryavaran Bhavan, Sector – 10A
Gandhinagar - 382010

Subject : Reply to your notice issued under section 31(A) of Air Act-1981 with outward no. 519683 dated 05/09/2019.

Reference: (i) Your Notice outward no. 519683 dtd. 05/09/2019
(ii) Our Letter No. Nayara Energy/27398/ENV/GPCB/2019/874 dtd 27/08/2019
(iii) Our Letter No. Nayara Energy/27398/ENV/GPCB/2019/870 dtd 21/08/2019
(iv) Our site XGN ID: 27398

Dear Sir,

With reference to the above subject matter, we would like to submit the below clarifications against the Notice issued to our industry vide letter dated 05/09/2019 received by post on 16/09/2019 based on observations recorded during Gujarat Pollution Control Board officials visit dated 02/08/2019:

1. **Heavy Dusting was observed in the sulphur storage area while loading into the truck during the inspection of your site**
   Process modification has been carried out for improvement in product quality. Now, instead of flakes, pellets are being generated by increasing the concentration of tegoprin (chemical).
   Apart from this, distance between chute and loading point of truck is reduced by increasing the height of the bottom platform of the truck.
   We have started using full body trucks only. We have completely stopped half body truck for sulphur loading.

2. **Below parameters were observed higher than the permissible limit in the analysis done in the waste water sample taken from ETP unit of your site SS- 26 mg/ l**
   This result came to us as surprise. We are having practice of taking counter effluent sample for all GPCB samples. Most of the time, effluent sample results of our lab matches with GPCB results. But, this time GPCB analysis results are more than our lab analysis report. GPCB counter sample analysis result for Suspended Solids by our lab is 16 mg/l, whereas GPCB lab results shows 26 mg/l.
   We request you to kindly do the resampling as there were no operational anomalies observed in our record so far as ETP performance is concerned. We are having DMF & ACF after secondary clarifier which ensures negligible carry over of Suspended Solids.

3. **During the site inspection, PM-162 mg/ Nm³ was observed in the stack attached to CDU-1 Unit and PM- 183 mg/ Nm³ was observed in the stack attached with FCC- Regenerator unit which are higher than the permissible limit**

   We would like to inform that we had clarified to your good office vide our Letter nos. Nayara Energy/ 27398/ENV/GPCB/2019/870 dtd. 21/08/2019 and Nayara Energy/27398/ENV/GPCB/2019 /874 dtd.

Registered Office:
Khambhalia, Post Box No.24, Dist. Devbhumi Dwarka, Gujarat 361 305, India
T +91 2833 661444 | F +91 2833 662929

CIN: U11100GJ1989PLC032116
www.nayaraenergy.com

Nayara Energy Limited (Formerly Essar Oil Limited)
5th Floor, Jet Airways Godrej BKC, Plot No. C-68, G Block,
Bandra Kurla Complex, Bandra East, Mumbai 400051, India

T +91 22 66 121800 | F +91 22 6708 2177
E refinery@nayaraenergy.com

27/08/2019 that there might have been some procedural error while collecting the said samples and requested for resampling.

Hereby we would like to clarify that we are having dual fired heaters. The dual fired heaters of Crude Distillation Unit are operated with Low Sulphur Fuel Oil (FO) in combination with Refinery Fuel Gas (FG). Our FO is having minimum nitrogen & ash content and contain less than 1.0 wt% sulphur. FO is properly atomized before firing in the heaters. The heaters are equipped with Atomizing Steam & FO differential pressure safety interlock to ensure adequate atomizing. Efficiency of Heaters is evaluated every day. The avg. thermal efficiency of the heaters are in the range 88 – 89 %. To ensure combustion quality, excess oxygen in flue gas is checked regularly. Excess oxygen stays in the range 3 – 5 %. It is therefore evident that there is no incomplete combustion and hence potential for particulate matter generation is negligible and well below the permissible limits.

There are two Regenerators in the FCCR system where one Regenerator is equipped with 4nos. of high efficiency-two stage cyclone separators and the other Regenerator is equipped with 3nos. of high efficiency-two stage cyclone separators. The Unit has been consistently performing at the most optimum operations since long and at very low consumption of fresh catalyst. We have not observed any operational upsets or change in catalyst consumption that warrants high catalyst carryover into stack.

We are having Online Monitoring Systems for CDU - PM,FCCR - PM,ETP - SS in place, and the same is hooked up with the CPCB Server and real time data is being transmitted to CPCB server continually. We are also continuously and simultaneously submitting real time data to GPCB also. For your kind perusal we would like to enclose the online data of the sampled dates as **Annexure – 1** which are well within the permissible limits. In addition to this NABL's accredited M/s Unistar Environment and Research Labs Pvt. Ltd., Vapi is also carrying out manual monitoring every month and monitoring report for the same is being submitted to GPCB regional office every month. Copy of the August Month report is attached as **Annexure-2**. Manual Monitoring results have consistently and continually also been found to be well within the permissible limits.

In view of the above clarifications duly supported by **Annexure- 1 & 2,** we trust that GPCB may kind find that there is no breach of any of the conditions contemplated under 31(A) of Air Act and therefore there is no occasion to issue any instruction under 31(A) of Air Act as indicated in Notice dated 05/09/2019.

We therefore humbly request that Notice dated 05/09/2019 issued to us under Section-31(A) of Air Act-1981 may kindly be withdrawn and treated as discharged for which we shall be ever grateful.

Thanking you,

Yours sincerely,

For, **Nayara Energy Limited,**

Maji 20.09.2019

S S Maji
(Head- Technical)

Enclosure: As mentioned above

Annexure - 1

ONLINE ANALYZER VALUES (Date.02.08.2019)

Unit	Parameter	GPCB Consent Limits	Online Analyzer Values
ETP Outlet	Suspended Solid	20 mg/ l	7 mg/l
CDU	PM	100 mg/ Nm^3	28 mg/ Nm^3
VDU	PM	100 mg/ Nm^3	15 mg/ Nm^3
FCC Regenerator	PM	100 mg/ Nm^3	37 mg/ Nm^3

Reference No. Nayara Energy/ENV/27398/MMR/2019/132
4th September 2019

To,
The Regional Officer,
Gujarat Pollution Control Board,
Sardar Patel Bhavan, Rameshwar Nagar,
Jamnagar – 361 008

Subject: Submission of Environmental Monitoring Reports for the month of August 2019

Reference: 1) CCA letter No: AWH - 81987, dtd: 13-10-2016
2) Facility XGN ID: 27398

Dear Sir,

With reference to the above, please find enclosed reports on environmental monitoring activities carried out during month of August 2019.

Annexure: I	Stacks' emission monitoring report
Annexure: II	Ambient air quality monitoring report
Annexure: III	Treated effluent monitoring report
Annexure: IV	Noise monitoring report

We would like to bring to your kind attention that as per the general condition No. 5.5 stipulated in our CC&A No. AWH 81987 dated 13.10.2016 granted to operate 21 MMTPA capacity refinery, M/s, Unistar Environment and Research Laboratory, Vapi has been hired as third party for environmental monitoring of our refinery site w.e.f month of March 2019.

This is for your kind information & records please.

Thanking you,
Yours faithfully,
For, Nayara Energy Ltd.,

Asmita Patel
(Head – Environment)

Enclosure: Annexure I to Annexure IV

Copy to: The Member Secretary, GPCB, Paryavaran Bhavan, Sector - 10 A, Gandhinagar-382010.

Registered Office:
Khambhalia, Post Box No.24, Dist. Devbhumi Dwarka, Gujarat 361 305, India
T +91 2833 661444 | F +91 2833 662929

CIN: U11100GJ1989PLC032116
www.nayaraenergy.com

Nayara Energy Limited (Formerly Essar Oil Limited)
5th Floor, Jet Airways Godrej BKC, Plot No. C-68, G Block,
Bandra Kurla Complex, Bandra East, Mumbai 400051, India

T +91 22 66 121800 | F +91 22 6708 2177
E refinery@nayaraenergy.com

UniStar
Environment and Research Labs Pvt. Ltd.

White House
Near G.I.D.C. Office, Char Rasta
Vapi-396 195, Gujarat, India
Phone : +91 260 2433968 / 2425910
Email : response@uerl.in Website : www.uerl.in

F&CC (GOI) Recognized Environmental Laboratory under the EPA-1986(12.01.2015 to 11.01.2020)
QCI-NABET Accredited EIA Consultant Organization
GPCB Recognized Environmental Auditor (Schedule-II)
OHSAS18001:2007 Certified Company
ISO 9001:2015 Certified Company

STACKs' EMMISION MONITORING REPORT OF NAYARA ENERGY LTD., VADINAR

ANNEXURE-I

Frequency of monitoring: Monthly

Period: For month August '2019

i) Emission through heaters/furnaces' stacks

Stack Attached to Unit	Type of Fuel	Date	Pollutant concentration in stacks emission									
			Particulate Matter (PM)		Sulphur Dioxide (SO_2)		Oxides of Nitrogen (NOx)		Carbon Monoxide (CO)		Ni + Vanadium	
			mg/Nm³	kg/Month	mg/Nm³	kg/Month	mg/Nm³	kg/Month	mg/Nm³	kg/Month	mg/Nm³	kg/Month
rude Distillation Unit - II (CDU - II)	Liquid Fuel	30.08.2019	79	14100	312	55687	98	17492	180	32127	BDL	-
aphtha Hydro Treater / ontinuous Catalytic Reforming HT/CCR)	Gas Fuel	08.08.2019	4	631	23	3619	100	15369	24	3968		
rude Distillation Unit (CDU)	Mixed Fuel	21.08.2019	65	21160	458	149094	276	89912	157	51108	BDL	-
accum Distillation Unit (VDU)	Mixed Fuel	21.08.2019	66	11150	124	20982	42	7112	169	28551	BDL	-
iesel Hydro De - Sulfurizatin DHDS)	Gas Fuel	06.08.2019	4	467	0	0	75	8762	0	0		
uidized Catalytic Cracking (FCC) eed Heater	Gas Fuel	07.08.2019	0	0	32	1663	41	2114	0	0		
ydrogen Manufacturing Unit - I HMU - I) Furnace	Gas Fuel	28.08.2019	1	381	24	9140	46	28823	23	8759		
ydrogen Manufacturing Unit - II HMU - II) Furnace	Gas Fuel	28.08.2019	1	248	44	21866	58	28823	22	10933		
iesel Hydro Treater (DHDT)	Mixed Fuel	26.08.2019	12	1940	9	1455	80	12931	0	0	BDL	-
GO Hydro Treater (VGOHT)	Mixed Fuel	26.08.2019	19	3797	0	0	64	12789	0	0	BDL	-
elayed Coker Unit (DCU - 1)	Gas Fuel	21.08.2019	3	351	38	4444	21	2456	56	6549		
elayed Coker Unit (DCU - 2)	Gas Fuel	21.08.2019	2	242	42	5077	46	5561	38	4594		
elayed Coker Unit (DCU - 3)	Gas Fuel	21.08.2019	0	0	32	4163	22	2862	45	5854		
PCB CC&A Limit for Liquid uel			**100**		**1700**		**450**		**200**		**5**	
PCB CC&A Limit for Gas fuel			**10**		**50**		**350**		**150**			

ote:(1) Liquid Fuel- Furnace oil, (2) Gas Fuel- Natural Gas/Fuel Gas, (3) Mixed Fuel (Oil + Gas)

UniStar
Environment and Research Labs Pvt. Ltd.

White House
Near G.I.D.C. Office, Char Rasta
Vapi-396 195, Gujarat, India
Phone : +91 260 2433966 / 2425070
Email : response@uerl.in Website : www.uerl.in

&CC (GOI) Recognized Environmental atory under the EPA-1986(12.01.2015 to 11.01.2020) | QCI-NABET Accredited EIA Consultant Organization | GPCB Recognized Environmental Auditor (Schedule-II) | OHSAS18001:2007 Certified Company | ISO 9001:2008 Certified Company

ACKs' EMMISION MONITORING REPORT OF NAYARA ENERGY LTD., VADINAR

ANNEXURE-I

quency of monitoring: Monthly

Period: For month August '2019

Emission through Processes' stacks

I

ack Attached to Unit	Date	Pollutant concentration In stack emission						
		Sulphur Recovery	Hydrogen Sulphide (H_2S)		Oxides of Nitrogen (NOx)		Carbon Monoxide (CO)	
		%	mg/Nm^3	kg/Month	mg/Nm^3	kg/Month	mg/Nm^3	kg/Month
lfur Recovery Unit (SRU)	06.08.2019	99.9	BDL	-	14	2200	34	5343
CB CC&A Limit		98.7	15		350		150	
lfur Recovery Unit (SRU - 1)	03.08.2019	99.9	BDL	-	20	4413	19	4193
CB CC&A Limit		98.7	15		350		150	

2

ack Attached to Unit	Date	Pollutant Concentration									
		Particulate Matter (PM)		Sulphur dioxide (SO_2)		Oxides of Nitrogen (NOx)		Carbon Monoxide (CO)		Ni + Vanadium	
		mg/Nm^3	kg/Month	mg/Nm^3	kg/Month	mg/Nm^3	kg/Month	mg/Nm^3	kg/Month	mg/Nm^3	kg/Month
idized Catalytic Cracking (FCC) Regenerator	07.08.2019	64	31332	158	77399	25	12043	318	155679	BDL	-
CB CC&A Limit		100		1700		450		400		5	

UniStar
Environment and Research Labs Pvt. Ltd.

White House
Near G.I.D.C. Office, Char Rasta
Vapi-396 195. Gujarat, India
Phone : +91 260 2433966 (24 Lines)
Email : response@uerl.in Website : www.uerl.in

&CC (GOI) Recognized Environmental ...tory under the EPA-1986(12.01.2015 to 11.01.2020) | QCI-NABET Accredited EIA Consultant Organization | GPCB Recognized Environmental Auditor (Schedule-II) | OHSAS 18001:2007 Certified Company | ISO ... Certified Company

BIENT AIR QUALITY MONITORING REPORT OF NAYARA ENERGY LIMITED., VADINAR

ANNEXURE-II

Period: Month- August'2019

quency : Once in a Week

Particulars/ Parameters	Unit	GPCB CC&A Limit	At 93 Gate				Refinery Main Gate				Labour Gate				PORT A CAMP				COT			
Date of Sampling			06.08.2019	13.08.2019	20.08.2019	26.08.2019	06.08.2019	13.08.2019	20.08.2019	26.08.2019	06.08.2019	13.08.2019	20.08.2019	26.08.2019	06.08.2019	13.08.2019	20.08.2019	26.08.2019	07.08.2019	14.08.2019	21.08.2019	29.08.2019
Duration of sampling	Hrs.		24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Wind Direction (From)			SE	SE	E	E	SE	SE	E	E	SE	SE	E	E	SE	SE	E	E	E	SE	E	SE
PM_{10}	$\mu g/m^3$	100 (TWA 24 Hrs)	69	71	65	77	66	72	68	76	68	75	62	78	64	79	72	68	70	69	72	74
$PM_{2.5}$	$\mu g/m^3$	60(TWA 24 Hrs)	19	20	18	23	18	21	19	23	20	22	18	24	17	24	21	19	23	21	20	22
Sulphur Dioxide (SO_2)	$\mu g/m^3$	80(TWA 24 Hrs)	14	16	13	19	18	22	19	19	15	17	14	19	15	20	18	16	21	23	18	19
Nitrogen Oxides (NO2)	$\mu g/m^3$	80(TWA 24 Hrs)	19	21	18	21	21	25	17	23	17	19	15	23	19	25	21	23	24	23	21	22
Carbon Monoxide (CO)	mg/m^3	2 (TWA 8 Hrs)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene	$\mu g/m^3$	5(TWA Annual)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a) - Pyrene	ng/m^3	1(TWA Annual)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

: TWA: Time Weighted Average, BDL: Below Detection Limit: 1) CO:1 mg/m³, 2) C_6H_6:1µg/m³,3) Benzo(a) - Pyrene:0.1ng/m³.

Tested By:

Patel.

hemist) / (Sr. Chemist)

ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI

Authorized By:

(Sr. Chemist)

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TEST REPORT

ANNEXURE- III

Report No.	URC /19/08/NEL/001	Date Of Report	24/08/2019
Name & Address of Customer	M/s. NAYARA ENERGY LIMITED. Khambhalia, Post Box No 24, Jamnagar, Gujarat-361305		
Sample Details	ETP Outlet Water Sample	Sample Qty.	5 Lit.
Sampling Date	06/08/2019	Sample Received Date	06/08/2019
Sampled By	Party.	Appearance Of Sample	Colourless
Test Started Date	06/08/2019	Test Completion Date	12/08/2019
UERL Lab Sample ID.No. 19/08/NEL/001			

TEST RESULTS

Sr. No.	Parameters	Test Method	Permissible Limit As per GPCB CC& A	Results
		PHYSICAL QUALITY		
1.	pH @ 25 ° C	IS 3025(Part 11)1983, (APHA 22nd Ed.,2012,4500-H+B)	6.5 – 8.5	7.89
2.	Total Suspended Solids (mg/L)	IS 3025(Part 17)1984; Amd.1 (APHA 22nd Ed.,2012,2540 –D),	20	10
		CHEMICAL QUALITY (In mg/L)		
1.	Oil & Grease	IS 3025(Part39)1991, Amd. 1	5.0	BDL
2.	Phenolic Compound as (C_6H_5OH)	(APHA 22nd Ed.,2012,5530-C)	0.35	BDL
3.	Sulphide as S^{-2}	(APHA 22nd Ed.,2012,4500 S^{-2} F)	0.5	0.37
4.	Chemical Oxygen Demand (COD)	IS 3025(Part 58)2006, (APHA 22nd Ed.,2012,5220-B),	125	20.8
5.	BOD (3 days at 27 °C)	IS 3025(Part44)1993, Amd. 1	15	5.5
6.	Ammonia Nitrogen	IS 3025(Part 34)1988, (APHA 22nd Ed.,2012,4500 NH_3-B&C),	15	BDL
7.	Cyanide as CN	IS 3025(Part27)1986	0.2	BDL
8.	Phosphorous as P	(APHA 22nd Ed.,2012,4500-P,D)	3.0	0.32
9.	Chromium as Cr	IS 3025(Part 52)2003, (APHA 22nd Ed.,2012,3111-B)	2.0	BDL
10.	Lead as Pb	IS 3025(Part 47)1994Amd.02, (APHA 22nd Ed.,2012,3111-B)	0.10	BDL
11.	Mercury as Hg	(APHA 22nd Ed.,2012,3112-B)	0.01	BDL
12.	Zinc as Zn	IS 3025(Part 49)1994, (APHA 22nd Ed.,2012,3111-B)	5.0	BDL
13.	Nickel as Ni	IS 3025(Part 54)2003, (APHA 22nd Ed.,2012,3111-B)	1.0	0.069
14.	Copper as Cu	IS 3025(Part 42)1992amd.01, (APHA 22nd Ed.,2012,3111-B)	1.0	0.052
15.	Vanadium as V	AAS	0.20	BDL

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TEST REPORT **ANNEXURE- III**

Report No.	URC /19/08/NEL/001	Date Of Report	24/08/2019
Name & Address of Customer	M/s. NAYARA ENERGY LIMITED. Khambhalia, Post Box No 24, Jamnagar, Gujarat-361305		
Sample Details	ETP Outlet Water Sample	Sample Qty.	5 Lit.
Sampling Date	06/08/2019	Sample Received Date	06/08/2019
Sampled By	Party.	Appearance Of Sample	Colourless
Test Started Date	06/08/2019	Test Completion Date	12/08/2019
UERL Lab Sample ID.No. 19/08/NEL/001			

TEST RESULTS

Sr. No.	Parameters	Test Method	Permissible Limit As per GPCB CC& A	Results
		CHEMICAL QUALITY (In mg/L)		
16.	TKN	(APHA 22nd Ed.,2012,4500 NH_3-B&C, &4500 N_{ORG}, B,	40.0	BDL
17.	Hexavalent Chromium as Cr+6	APHA 22nd Ed.,2012,3500CrB	0.10	BDL
18.	Benzene	Extraction and GC Method	0.10	BDL
19.	Benzo(a) Pyrene	Extraction and GC Method	0.20	BDL

***Note: N.D.** = Not Detectable, **MDL** = Minimum Detection Limit: 1) Oil & Grease: 2.0, 2) Phenolic Compound: 0.1, 3) Ammonia Nitrogen: 2.0, 4) Cyanide: 0.05, 5) Chromium: 0.05, 6) Lead: 0.01, 7) Mercury: 0.001, 8) Zinc: 0.05, 9) Vanadium: 0.01,10) TKN: 2.0, 11) Hexavalent Chromium: 0.05,12) Benzene: 0.001, 13) Benzo(a) - Pyrene: 0.001*

******* End of Report *******

Tested By (Chemist)

Checked By (Sr. Chemist)

Authorized By (Technical Manager)

ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI

NOISE LEVEL MONITORING REPORT OF NAYARA ENERGY LTD.,VADINAR

Frequency: Monthly

ANNEXURE - IV

Period: For month August 2019

Sr. No.	Location	Avg. Noise Level, dB(A) during Day Time	Avg. Noise Level,dB(A) during Night Time
		06:00 am to 10:00 pm	10:00 pm to 06:00 am
Date of Monitoring : 13-08-2019			
1	Port A Camp	50.2	49.7
2	Labour Gate	51.6	50.8
3	West side of Main Flare	51.4	51.0
4	Nr. Batching Plant	52.0	50.9
5	93 Gate	51.8	51.5
6	Storm water drain outlet	52.2	52.0
7	Refinery Main Gate	51.2	50.6
8	Essar Petrol Pump (Near Delhi Darbar)	53.0	52.4
9	Pet Coke Rail Loading Yard	52.6	51.4

Note:

[1] These locations are monitored to comply with Noise Pollution (Regulation & Control) Rules, 2000 under Environment Protection Act 1986 requirements.

[2] AAQ standards in terms of Noise for industrial area : Day time : 75 dB(A); Night time : 70 dB(A)

Annexure 2

List of All Clearance Taken for Existing Refinery as well as for Proposed Expansion with Petrochemical Complex

Sr. No.	Item/Permission	Letter/ Ref No. / dt.	Issued by	Valid up to	No. of Pages
1.	Amendment for name change from Essar Oil Limited (EOL) to Nayara Energy Limited in Environmental Clearance for Expansion of Refinery Capacity from 9 MMTPA to 60 MMTPA with petrochemical complex	J-11011/320/2006-IA-II(I), 20th July,2018	MoEF&CC	16.09.2018	2
2.	EC Extension for Expansion of Refinery Capacity from 9 MMTPA to 60 MMTPA with petrochemical complex	J-11011/320/2006-IA-II(I), dated March 7, 2014	MoEF&CC	5 Years from date of issue	1
3.	Expansion of Refinery Capacity from 9 MMTPA to 60 MMTPA along with petrochemical complex	J-11011/320/2006-IA-II(I), dated Sept 16, 2008	MoEF&CC	5 Years from date of issue	9
4.	Diversion of 15.49 ha of Forest land for laying of pipeline construction of jetty and offshore facilities under Forest Conservation Act,1980	8C/12/385/96-FCW dated Dec 8, 1999	MoEF&CC	One time	2
5.	CRZ Clearance for construction of jetty, approach to jetty, SBM and crude and product pipelines of M/s Essar Oil Ltd. at Vadinar	No. 16011/22/2000-1A-III dated Nov 3, 2000	MoEF	One time	6
6.	WLPA Clearance for laying of pipeline and construction of jetty etc. of Essar Oil Ltd. near Vadinar passing through Forest Area/ MNP/MNS at Jamnagar.	FCA/WLP/29/1043-48/2003-04 dated Feb 27, 2004	PCCF, Gujarat State	One time	5
7.	Amendment in Consent to Establish (CTE) for name change to Nayara Energy Ltd.	PC/CCA-JMN-336 (19)/ID-27398/ 464860, Aug 06, 2018	GPCB	13.03.2019	1
8.	Extension of the validity of Consent to Establish (NOC) of the Board	PC/CCA-JMN-366 (8)/ID-27398/ 313362, May 07, 2015	GPCB	13.03.2019	1
9.	Amendment in CTE for Bifurcation to Vadinar Power Company Ltd. & Essar Oil Ltd.	PC/CCA-JMN-366(4)/13800, Dated July 04,2009	GPCB	5 Years from date of issue	1
10.	Combined Consent to	PC/CCA-JMN-	GPCB	5 Years	13

	Establishment (NOC) under Water and Air Act 1981for EOL and VPCL	366/5383 dated March 13, 2009		from date of issue	
11.	Amendment of Consolidated Consent & Authorization (CCA) for Name change to Nayara Energy Limited	PC/CCA-JMN-336(19)/ ID-27398/ 464858 dated Aug 6, 2018	GPCB	16.09.2022	1
12.	Correction in renewal of the consolidated consent & Authorization of the board.	PC/CCA-JMN-366 (17)/ID-27398/ 413519, 26/05/2017	GPCB	16.09.2022	3
13.	Consolidated Consent and Authorization	AWH-81987 dated Oct 13, 2016	GPCB	16.09.2022	8
14.	License to work a factory under Factory Act,1948	License No. 32 dated June 30, 2006	Directorate Industrial Safety and Health State	31.12.2021	1

F. No. J-11011/320/2006-IA-II(I)
Government of India
Ministry of Environment, Forest and Climate Change
(IA- II Section)

Indira Paryavaran Bhawan
Jorbagh Road, New Delhi -3
Dated: 20th July, 2018

To

M/s Nayara Energy Limited,
Khambhalia, P.O. Box. 24,
District **Devbhumi Dwarka**- 361 305 (Gujarat)

Sub: Expansion of Refinery capacity from 9 MMTPA to 60 MMTPA with petrochemical complex at Khambalia, Jamnagar (Gujarat) - Transfer of Environmental Clearance - reg.

Sir,

This has reference to your proposal No.IA/GJ/IND2/75193/2013 dated 27th June, 2018 regarding transfer of environmental clearance dated 16th September, 2008 to the above project, from M/s Essar Oil Ltd to M/s Nayara Energy Limited.

2. The Ministry had earlier granted environmental clearance vide letter dated 16th September, 2008 to the project for expansion of refinery capacity from 9 MMTPA to 60 MMTPA with petrochemical complex in favour of M/s Essar Oil Ltd. The validity of the said environmental clearance was extended for a period of five years i.e. upto 15th September, 2018.

3. Pursuant to the provisions of the Companies Act, 2013 followed by Certificate of Incorporation dated 25th May, 2018 issued by O/o Registrar of Companies, Ministry of Corporate affairs, name of the company has been changed M/s Essar Oil Ltd to M/s Nayara Energy Limited, and thus necessitating transfer of all requisite approvals in the new name of the company.

4. M/s Nayara Energy Limited has submitted an affidavit to abide by the terms and conditions stipulated in the environmental clearance dated 16th September, 2008 issued in the name of M/s Essar Oil Ltd.

5. As per the relevant provisions of the EIA Notification, 2006, the environmental clearance granted by the Ministry to M/s Essar Oil Ltd on 16th September, 2008 and its extension vide letter dated 7th March, 2014 to the project for expansion of refinery capacity from 9 MMTPA to 60 MMTPA with petrochemical complex at Khambalia, Jamnagar (Gujarat), is hereby transferred from M/s Essar Oil Ltd to M/s Nayara Energy Limited on the same terms and conditions under which prior environmental clearance was initially granted.

6. This issues with approval of the competent authority.

20/7/2018

(S. K. Srivastava)
Scientist E

Copy to:-

1. The Secretary, Forests & Environment department, Government of Gujarat, Sachivalaya, 8th Floor, **Gandhinagar** (Gujarat)
2. The Additional Principal Chief Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (WZ), E-5, Kendriya Paryavaran Bhawan, E-5 Arera Colony, Link Road-3, Ravishankar Nagar, **Bhopal** - 462016 (Madhya Pradesh)
3. The Member Secretary, Central Pollution Control Board, Parivesh Bhavan, East Arjun Nagar, **Delhi** - 32
4. The Member Secretary, Gujarat Pollution Control Board, Paryavaran Bhavan, Sector-10 A, **Gandhinagar** - 382010 (Gujarat)
5. Monitoring Cell, Ministry of Environment, Forest and Climate Change, New Delhi
6. Guard File/Monitoring File/Record File

20/7/2018

(S. K. Srivastava)
Scientist

सत्यमेव जयते

Government of India
Ministry of Environment and Forests

F. No. J-11011/320/2006-IA II (I)

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi – 110 003

E-mail : tchand2003@yahoo.co.uk
Telefax : 011: 24363963

To

Dated: 7th March 2014

Shri C Manoharan, Director Refinery
M/s Essar Oil Ltd,
PO Box No. 24, Head P O Khambalia
District Jamnagar, Gujarat-361305.
FAX: 2833-661444

Subject: Expansion of Refinery Capacity from 9.0 MMTPA to 60 MMTPA with Petrochemical Complex at Khabalia, Jamnagar, Gujarat by M/s Essar Oil Ltd. **–Extension of validity of Environment Clearance- regarding.**

Sir,

This is with reference to this Ministry's environmental clearance dated 20.07.2007 and 16.09.2008 and your letter No. EOL/MoEF/Extension of EC /2012/294 dated 17.03.2012 and letter of even no dated 5th June, 2013 seeking extension of validity of environmental clearance for a period of five years.

2. The proposal referred above was placed before the Reconstituted Expert Appraisal Committee (Industry) in its 12th meeting held during 31st September 2013 – 1st October 2013. The Committee recommended for the extension of validity of Environmental Clearance by a period of five years.

3. The Ministry accepts the recommendation of the Reconstituted Expert Appraisal Committee (REAC) (Industry) and extends the validity of the EC letter no. J-11011/320/2006-IA II (I) dated 16th September, 2008 for a period of five years w.e.f 16.09.2013 until 15.09.2018.

4. This issues with the approval of Competent Authority.

(Dr. T. Chandini)
Director

Copy to :

The Chairman, Gujarat Pollution Control Board, Paryavaran Bhavan, Sector – 10, A, Gandhi Nagar - 382 010, Gujarat (E-mail: chairman@gpcb.gov.in ; Fax No.: 079-23232156)

भारत सरकार
पर्यावरण एवं वन मंत्रालय
Government of India
Ministry of Environment & Forests
(IA Division)

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi – 110 003
E-mail: plahujarai@yahoo.com
Telefax: 011: 2436 3973

File No: J-11011/320/2006-IA-II(I) **September 16, 2008**

To,

M/s. Essar Oil Ltd.
Premchand House Annexe
Behind Popular House, Ashram Road
Ahmedabad – 380 009.
Gujarat.

Subject: Expansion of refinery capacity from 9.0 MMTPA to 60 MMTPA with Petrochemical Complex at Khambalia, Jamnagar, Gujarat by M/s. Essar Oil Ltd. – Environmental Clearance reg.

Sir,

Kindly refer to your letter No:EOL/MOEF/VPCL-Bifurcation/2008, dated 1st March 2008 where in you have requested the Ministry for the bifurcation of the environmental clearance accorded by the Ministry for the expansion project of 9.0 MMTPA refinery to 60 MMTPA along with 780 MW Captive Power Plant and Petrochemical Complex at Khambalia, Jamnagar, Gujarat vide File No: J-11011/320/2006-IA-I1 (I) Dated 20th July 2007 with a total cost of Rs.78,730 Crores in the name of two group companies (i) Essar Oil Limited (EOL) and (ii). Vadinar Power Company Limited (VPCL)

2. The Ministry of Environment and Forests (MoEF) has examined the request of M/s. Essar Oil Limited and observed that there will be no change in location, technology, process, products, emission and effluent waste generation. Accordingly, Ministry bifurcates the environmental clearance in favor of M/s. Essar Oil Limited and M/s. Vadinar Power Company Limited under the provisions of EIA Notification dated 14th September 2006.

3. It is noted that bifurcation of the earlier environmental clearance in the name of group companies viz. (i) Essar Oil Limited (EOL) and (ii) Vadinar Power Company Limited (VPCL) is for the administrative and commercial reasons. This environmental clearance is in the name of the M/s. Essar Oil Limited is issued for the refinery expansion in three phases. The first phase is an increase in refinery capacity from 9 MMTPA to 10.5 MMTPA by de-bottlenecking and the phase II involves the increase in refinery capacity from 10.5 MMTPA to 32 MMTPA and some units of Petrochemical Complex and the phase III involves the increase in refinery capacity from 32 MMTPA to 60 MMTPA, completion of the petro-chemical complex. Details of refinery product profile for Phase I, II, III is given in **Annexure I** and the Petrochemical product profile is given in **Annexure II.** Land Requirement for the proposed project is 2290 Ha which is already available with the project Proponent. It is reported that emission load of SO_2 in various phases with

R.C/R.A.L.Y
19/9/08

processing of crude with sulphur content up to 2.63% will come down even with increased production capacity in view of better efficiency of desulphurization and sulfur recovery units. From Phase II to III, the Sulfur dioxide emissions would increase in proportion to the increase in capacity. The water requirement of the refinery and petrochemical complex will be met from sea water desalination and no water will be drawn either from ground or from the surface. Clearance has been obtained for the intake of submarine seawater intake line and discharge lines which are passing through the marine national park. The existing pipelines corridor will be adequate for both intake and discharge lines as well as for the crude. In respect of product pipelines the existing corridor will be adequate for 32 MMTPA (Phase-II). For the third phase, product pipelines will be routed through another pipeline leading to the proposed facility at Salaya. It was reported that in case of failure of the LPG sphere, the consequences will be limited within the plant boundary. The Public Hearing for the project was carried out on 17.10.2006. Cost of this refinery expansion project along with petrochemical complex is Rs. 73,532 Crores.

4. The proposal was placed before the Expert Appraisal Committee (I) in its 83rd meeting held on 14-16th July, 2008. Committee recommended for bifurcation of environmental clearance of even no. dated 20th July, 2007 accorded under the Environmental Impact Assessment Notification, 2006. The Public Hearing for the project was carried out on 17.10.2006.

5. Based on the information submitted by the project proponent, the Ministry herby bifurcates the environmental clearance in to M/s. Essar Oil Limited for expansion of refinery from 9.0 MMTPA to 60MMTPA and M/s. Vadinar Power Company Limited for expansion of 77MW to 780MW under the provisions of EIA Notification dated 14th September 2006.

6. This environmental clearance super cedes the earlier environmental clearance issued by Ministry of environment & Forests vide letter No; J-11011/320/2006 –IA-II(I) dated 20th July 2007. This environmental clearance is for expansion of refinery capacity from 9 MMTPA to 60MMTPA along with petrochemical complex is subject to the strict compliance of the following specific and general conditions:

A. Specific Conditions

i. M/s Essar Oil Limited shall comply with new standards/norms for Oil Refinery Industry notified under the Environment (Protection) Rules, 1986 vide G.S.R. 186(E) dated 18th March 2008. The design of refinery unit shall incorporate process features and equipments to comply with the emission and effluent standards for petroleum refinery.

ii. The gaseous emissions (SO_2, NO_x, H_2S, NH_3, NMHC, HC, VOC and Benzene)from various process units shall conform to the standards prescribed by the concerned State Pollution Control Board. All the measures detailed in the EMP and response to the Public Hearing shall be taken to control the point/stack and fugitive gaseous emissions from the proposed facilities for ensuring that the ambient air quality around the Refinery due to the expansion is maintained with in prescribed limits under the E (P) A, 1986.

iii. The company shall conform to the process vent standards for organic chemicals including non- VOCs and all possible VOCs i.e. TOCs standards and process vent standards for top priority chemicals. Regular monitoring shall be carried out for VOC and HC and On-line monitors for VOC measurements may be installed.

iv. The total SO_2 emission load for 32 MMTPA refinery capacity and petrochemical complex will be below 24.60 tonnes/day and for III phase of 60 MMTPA production and petrochemicals shall not exceed 38.69 tonnes/day. Regular record on Sulphur emission shall be maintained as part of the environmental data records. Sulphur Recovery Unit (SRU) of 99 % Sulfur removal will be established and efficiency will be monitored at regular intervals. Performance evaluation will be done for all these activities on annual basis to check adequacies and improve on the deficiencies.

v. On line monitoring shall be carried out for stack emissions of SO_2 & NO_x contributed mainly from CDU, VDU, SRU etc and data shall be transferred to the CPCB and SPCB regularly. The instruments used for ambient air quality monitoring shall be calibrated regularly. The monitoring protocol shall ensure continuous monitoring of all the parameters.

vi. The existing plant is using low NOx burners and the same or the one which are more efficient than the existing shall be used for the expansion project too in all furnaces / heaters.

vii. The Company shall install Hydro-Desulphurization and Sulphur Recovery Units with efficiency of more than 99%.

viii. For additional LPG storages, refrigerated storage or mounded bullets shall be installed.

ix. Low Sulphur internal fuel oil and fuel gas shall be fired in process heaters.

x. Quarterly monitoring of fugitive emissions will be carried out by Fugitive Emission Detectors (GMI Leak Surveyor). Guidelines of CPCB shall be followed for monitoring fugitive emissions.

xi. Floating roof double seal tanks will be provided to reduce the VOC fugitive emission. For management of fugitive emissions, all unsaturated hydrocarbons will be routed to the flare system. The flare system shall be designed for smokeless burning.

xii. Flare Gas Recovery System shall be installed for reduction of Hydrocarbon loss and emission of VOCs, NOx, N_20, SO_x & CO_2 to the environment.

xiii. FCC shall be provided with an ESP and other sources of particulate will be controlled to meet E (P) Act standards.

xiv. Regular Ambient Air Quality Monitoring shall be carried out. The location and results of existing monitoring stations will be reviewed in consultation with the concerned State Pollution Control Board based on the occurrence of maximum ground level concentration and downwind direction of wind. Additional Stations shall be set up, if required. It will be ensured that at least one monitoring station is set up in up-wind & in down-wind direction along with those in other direct ions.

xv. The practice of acoustic plant design shall be adopted t o limit noise exposure for personnel to an 8 hr time weighted average of 90 dB (A).

xvi. All the pumps and other equipment's where there is a likelihood of HC leakages shall be provided with LEL indicators and Hydrocarbon detectors. Provision for immediate isolation o f such equipment, in case of a leakage will also be made. The company shall provide a well defined Leak Detection and Repair (LDAR) programme for quantification and control of fugitive emissions. The detectors sensitivity will be in ppm levels.

xvii. The product loading gantry shall be connected to the product sphere in closed circuit through the vapour arm connected to the tanker. Data on fugitive emissions from here shall be regularly monitored and records will be maintained.

xviii. The company shall ensure that no halogenated organic is sent to the flares. If any of the halogenated organic are present, then the respective streams may be incinerated, if there are no technically feasible or economically viable reduction/recovery options. Any stream containing organic carbon, other than halogenated shall be connected to proper flaring system, if not to a recovery device or an incinerator.

xix. Water requirement of the refinery and petrochemical complex shall be met from sea water desalination and no water shall be drawn either from the ground or from the surface.

xx. No discharge of waste water from sweet water ETP shall be carried out. The quantity of sweet waste water generation is 3726 m^3/hr from the project . This effluent after appropriate treatment will be reused in process/ utilities or cooling or for green belt development.. Only brine from desalination plant and cooling tower blow down will be discharged to sea through a well designed diffuser at a location identified by National Institute of Oceanography. The quantity of return sea water is 26932 m^3/hr.

xxi. Regular monitoring of relevant parameters for the under ground water in the surrounding areas will be undertaken and the results will be submitted to the relevant States Pollution Control Board.

xxii. All organic waste shall be sent to incinerator only. For potential of heat recovery, the possibility of installing incinerator at site shall be explored and plan may be submitted to the SPCB. Alternatively, it will be sent for use as fuel in the cement kiln.

xxiii. Solid waste generated as Pretreater and Reformer Catalysts, Sulphur guard absorbent and Alumina Balls will be disposed off as per the authorization from the State Pollution Control Board. Spent catalysts shall be regenerated and waste oil will be sold to the registered recyclers only

xxiv. Oily sludge shall be sent to melting pit treatment for recovery of oil. The recovered oil shall be recycled into the refinery system. The residual sludge will be stored in HDPE lined pit for disposal after treatment. The sludge will be incinerated in the premises only.

xxv. The project authorities shall strictly comply with the provisions made in Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended in 2000 for handling of hazardous chemicals. Necessary approvals from Chief Controller of Explosives must be obtained before commissioning of the expansion project. Requisite On-site and Off-site Disaster Management Plans will be prepared and implemented. Regular mock drills shall be carried out for both On-site and Off-Site plans.

xxvi. Green belt shall be provided to mitigate the effects of fugitive emissions all around the plant in a minimum of 33% of the plant area in consultation with DFO as per CPCB guidelines.

xxvii. The company shall strictly follow all the recommendations mentioned in the Charter on Corporate Responsibility for Environmental Protection (CREP).

xxviii. The Company shall harvest surface as well as rainwater from the rooftops of the buildings proposed in the expansion project and storm water drains tore charge the ground water and use the same water for the various activities of the project to conserve fresh water.

xxix. Occupational Health Surveillance of the workers shall be done on a regular basis and records be maintained as per the Factories Act.

xxx. All the recommendations made in the EIA/EMP and Risk Assessment Reports in respect of environmental management and risk mitigation measures relating to refinery and petrochemical complex shall be implemented. In respect of activities in the marine national park, the recommendations of NIO shall be followed for protection of marine national park.

xxxi. The company shall undertake all relevant measures, as indicated during the Public Hearing for improving the Socio-economic conditions of the surrounding area. CSR activities will be undertaken by involving local villages and administration

B. GENERAL CONDITIONS

i. The project authorities must strictly adhere to the stipulations made by the concerned State Pollution Control Board (SPCB) and the State Government.

ii. No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment and Forests.

iii. At no time, the emissions should go beyond the prescribed standards. I n the event of failure of any pollution control system adopted by the units, the respective unit should be immediately put out of operation and should not be restarted until the desired efficiency has been achieved.

iv. Adequate number of influent and effluent quality monitoring stations shall be set up in consultation with the SPCB. Regular monitoring shall be carried out for relevant parameters for both surface and ground water.

v. Industrial wastewater shall be properly collected and treated so as to conform to the standards prescribed under GSR 422 (E) dated 1st May 1993 and 3lst December, 1993 or as amended from time to time. The treated wastewater shall be utilized for plantation purpose.

vi. The overall noise levels in and around the plant area shall be limited within the prescribed standards by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels shall conform to the standards prescribed under EPA Rules, 1989 vis. 75 dBA (day time) and 70 dBA (night time).

vii. Authorization from the State Pollution Control Board must be obtained for collections/treatment/storage/disposal of hazardous wastes.

viii. The project authorities will provide Rs. 3853.00 Crores to implement the conditions stipulated by the Ministry of Environment and Forests as well as the State Government. Adequate funds for recurring expenditure shall also be provided. The funds so provided shall not be diverted for any other purposes.

ix. The stipulated conditions will be monitored by the concerned Regional Office of this Ministry /Central Pollution Control Board/State Pollution Control Board. A six monthly compliance report and the monitored data shall be submitted to them regularly. It will also be displayed on the Website of the Company.

x. The date of Financial Closure and final approval of the project by the concerned authorities and the date of commencing the land development work as well as the commissioning of the project will be informed to the Ministry and its Regional Off ice.

xi. Proper House keeping and adequate occupational health programes shall be taken up. Regular Occupational Health Surveillance Programme for the relevant diseases shall be carried out and the records shall be maintained properly for at least 30-40 years. Sufficient preventive measures shall be adopted to avoid direct exposure to emission and other Hydrocarbons etc.

xii. A separate environment management cell with full fledge laboratory facilities to carry out various management and monitoring functions shall be set up under the control of a Senior Executive.

7. The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

8. The Ministry reserves the right to stipulate additional conditions if found necessary. The company will implement these conditions in a time bound manner.

8. Any appeal against this environmental clearance shall lie with the National Appellate Authority, if preferred, within a period of 30 days as prescribed under section 11 of the National Environment Appellate Authority Act, 1997.

10. The above conditions will be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Public Liability Insurance Act, 1991, Hazardous Waste (Management & Handling) Rules, 1989 and Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 along with their amendments and rules.

Yours faithfully,

(Dr.P.L. Ahujarai)
Director

Copy to:

1. The Secretary, Forests & Environment Department, Government of Gujarat, Sachivalaya, 8th Floor, Gandhi Nagar-382 010, Gujarat.
2. The Chief Conservator of Forests (Western Zone), Ministry of Environment & Forests, Regional Office, E-5, Arera Colony, Link Road -3,Bhopal -462 016.
3. The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
4. The Chairman, Gujarat State Pollution Control Board, Paryavaran Bhawan, Sector 10 A, Gandhi Nagar-382 043, Gujarat.
5. Adviser (CCI-I) Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, New Delhi.
6. Monitoring Cell, Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, New Delhi.
7. Guard File
8. Monitoring File
9. Record File.

(Dr.P.L. Ahujarai)
Director

Annexure – I

Refinery Product Profile			
Crude	10.5 MMTPA	32 MMTPA	60 MMTPA
Products			
1. LPG	0.65	2.16	2.77
2. SKO	0.76	0.40	0.80
3. ATF	0.4	2.50	3.70
4. HSD	4.81	11.15	20.98
5. PC Naptha	0.27	1.49	2.67
6. Gasoline	1.85	9.75	19.50
7. FO MV2	3	0.50	0.50
8. Sulphur	0.03	0.75	1.84
9. Coke		1.811	5
10. Bitumen		0.6	0.38
11. Asphaltene Prills		1	
12. Clarified Slurry Oil		0.5	1

Annexure II

PETROCHEMCIAL PRODUCT PROFILE

S.No.	Units	Capacity, KTA
1.	Oxo Alcohols	137+ 150
2.	Phenol/ Acetone/Bisphenol –A	200/120/150
3.	Propylene	1000
4.	IPA	75
5.	LLDPE-HDPE/HDPE	400/400
6.	PP	650+550
7.	Acrylic Acid	160+80
8.	Para Xylene/PTA	800/600
9.	Linear Alkyl Benzene (LAB)	200
10.	Benzene	260
11.	MTBE or ETBE	138 or 152
12.	Ethyl Benzene/Styrene	500
13.	Styrene	39
14.	Butadiene	180
15.	Butene -1	55
16.	MEG	700

P. Ahujaram

Government of India

Paryavaran Bhawan,
New Delhi 110 003

No. 8C/12/385/96-FCW

8th December, 99

To

The Secretary (Forests),
Govt. of Gujarat,
GANDHINAGAR

Sub:-Diversion of 15.49 ha. of forest land for laying of pipeline construction of jetty and off shore facility and widening/ extension of bund roads for Essar Oil Ltd. in District Jamnagar, Gujarat.

Sir,

I am directed to refer to your letter No. FCA/1096/1663/K dated 26.7.96 on the above mentioned subject seeking approval of the Central Government in accordance with S of Forest (Conservation) Act, 1980.

After careful consideration of the proposal of the State Govt., Central Govt., hereby conveys its approval under Section-2 of Forest (Conservation) Act, 1980 for diversion of 15.49 ha. of forest land for laying of pipeline, construction of jetty and off shore facility and widening/extension of bund roads for Essar Oil Ltd. in District Jamnagar subject to following conditions:

1. Legal status of forest land shall remain unchanged.

2. The non - forest land transferred in favour of Forest Department shall be declared as protected/reserved forest.

3. The compensatory afforestation shall be raised over non forest land at the cost of user agency.

4. The conditions stipulated from (iii) to (xx) vide this office letter of even no. dated 27.11.97 shall be strictly followed and compliance report should be sent to this office and Regional Office, Bhopal from time to time.

5. The forest land shall not be used for any purpose other than that specified in the proposal.

6. Any other condition that the State Govt. may impose from time to time for the protection and the improvement of the flora and fauna in the forest area.

7. This approval will be without prejudice to the case going on in the lower court.

8. In view of the violation reported by the CCF(WL) and Nodal officer, vide his d.o. letter no. WL/LND/CS/21/JMR/A/2055-57/99-2000 dt 31.8.99, penal compensatory afforestation will be carried out orer degraded forests twice in extent of the area worked in violation.

9. As State Government was informed by this office of even no. dated 7.11.97 that there should be a temporary moratorium on all future off-shore and on-shore industrial activity in this region for the time being and any future plan for industrialisation should be taken up only after conducting a comprehensive carrying capacity assessment of the region, the report of the study should be furnished by the State Government as early as possible.

10. This clearance is subject to grant of permission by the State Government to carry out proposed activity in the National Park/Sanctuary under the Wild Life (Protection) Act, 1972. It is further clarified that this clearance will have no bearing on the actions already initiated by the State Government under the Indian Forest Act and Wild Life (Protection) Act.

Yours faithfully,

(V.B. KUMAR)
Asstt. Inspector General of Forests

Copy to:

1. The Principal Chief Conservator of Forests, Govt. of Gujarat, Gandhinagar.
2. The Nodal Officer, C/o PCC, Govt. of Gujarat, Gandhinagar.
3. The CCF(C), Regional Office, Bhopal
4. RO(HQ), New Delhi
5. Guard file.
6. M/S Essar Oil Ltd.

V.B. Kumar 9/12/99

(V.B. KUMAR)
Asstt. Inspector General of Forests

No.16011/22/2000-IA-III
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan,
CGO Complex, Lodi Road,
New Delhi – 110 003

November 3, 2000

Sub : **CRZ Clearance for construction of Jetty, approach to jetty, SBM and crude and product pipelines of M/s ESSAR Oil Ltd. at Vadinar, Jamnagar, Gujarat regarding.**

Sir,

Reference is invited to the letter No. ENV-1096-GOI-1421-PI dated 5.7.2000 from Forests and Environment Department, Govt of Gujarat regarding the subject mentioned above. Subsequent information/documents submitted by M/s ESSAR Oil Limited vide their letter No. ES/OP/1536 dated 7th August, 2000, No. EOL/BOM-MOEF/dated 28th September, 2000 have been considered.

The proposal is for construction of a Single Buoy Mooring (SBM) at a distance of about 3 km from the second SBM of IOC in the deep sea, a product jetty, an approach to the jetty, crude and product pipelines, intake/return sea water pipeline and associated structures/facilities. The Land Fall point for the submarine pipeline will be on the Narara Bet at a distance of about 75 meters from the existing IOC pipelines. Thereafter the alignment of the pipeline will be on the existing bund almost parallel to the IOC pipeline corridor. The proposed site falls in the jurisdiction of Kandla Port Trust. The proposal has been examined in the Ministry of Environment and Forests and environmental clearance to this project is hereby accorded subject to the effective implementation of the following terms and conditions.

A. <u>Specific Conditions.</u>

1 All the conditions stipulated by Forests and Environment Department, Government of Gujarat as contained in their letter no. ENV-1096-GOI-1421-PI dated 5.7.2000 while according CRZ clearance and letter No. FCA-1096-1663-K dated 16.10.97 while granting permission for Right of Way through the Marine National Park/Sanctuary shall be effectively implemented.

2 All the conditions stipulated by the Forestry Wing of the Ministry of Environment and Forests while according forestry clearance vide their letter No. 8C/12-385/96-FCW dated 8.12.99 shall be effectively implemented.

3 The project shall be implemented in such a manner that there is minimum damage to the corals

(2/6)

4. Mangroves afforestation shall be taken up in at least 3 times the area of mangroves to the affected as a result of the project

5 No dredging, including maintenance dredging shall be undertaken for implementation of the project without prior approval of this Ministry.

6. The project authorities shall spell out the necessary precautionary measures to be taken to avoid any disturbance due to unequal settlement, while laying down the pipeline in the inter tidal area where the sub soil conditions are poor.

7 It shall be ensured that there is no displacement of fishing activity as a result of the project.

8. Worst case scenario of ship to ship collision shall be considered for risk assessment. The maximum quantity of crude which is likely to find its way into the coastal waters under different accident scenarios and their impact on aquatic life shall be studied after demarcating the impact zone. On the basis of such studies, the necessary action plan to mitigate the likely impacts shall be prepared before commencement of the operations. Action taken report in this regard shall be submitted to the Ministry.

9. A Disaster Management Plan and oil spill contingency plan should be prepared to take care of the large scale spillage including those in the event of any ship to ship collision, ship grounding etc.

10. The proposed location of control room should be re-examined to ensure the safety of the persons working there during any emergency situation.

11. Regular mock drills shall be carried out to ensure fitness of equipment in place.

12. It shall be ensured that due to the project, there is no adverse impact on the drainage of the area, recharge of ground water and the existing mangroves. The port should be equipped with skimmers, booms, absorbents, salvage pump, salvage barge, barriers and fire fighting equipments for handling the oil spill situation before the project is put into commission.

13 The project proponents should make specific arrangement for rain water harvesting in the project design and the rain water so harvested should be optimally utilized.

3/6

B. General Conditions :

(i) Construction of the proposed structures should be undertaken meticulously conforming to the existing Central/local rules and regulations. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned State Government Departments/Agencies.

(ii) The proponent shall ensure that as a result of the proposed constructions ingress of the saline water into the ground water does not take place. Piezometers shall be installed for regular monitoring for this purpose at appropriate locations on the project site.

(iii) A comprehensive contingency plan in collaboration with the concerned authorities must be formulated to contain in case of any oil spills. Appropriate devices such as oil skimmer, oil monitor, oil water separator must be acquired for strengthening the contingency plan. All the service vessels that are required for oil spill operations must be equipped with booms and dispersants. The personnel on board of these vessels must be properly trained in operation of these booms and dispersants.

(iv) The operation plan for responding to an oil spill must include clear procedures for notification of a spill, response decisions, clean up operations, communications, termination of cleanup operations, cleanup cost, oil pollution, damage control and disaster management plan.

(v) A well-equipped laboratory with suitable instruments to monitor the quality of air and water shall be set up so as to ensure that the quality of ambient air and water conforms to the prescribed standards. The laboratory will also be equipped with qualified manpower including a marine biologist so that the marine water quality is regularly monitored in order to ensure that the marine life is not adversely affected as a result of implementation of the said project. The quality of ambient air and water shall be monitored periodically in all the seasons and the results should be properly maintained for inspection of the concerned pollution control agencies. The periodic monitoring reports at least once in 6 months must be sent to this Ministry as well as its Regional Office at Bhopal.

(vi) The project affected people, if any should be identified and properly compensated and rehabilitated.

(vii) Adequate provisions for infrastructure facilities such as water supply, fuel for cooking, sanitation, etc. must be provided for the labourers during the construction period in order to avoid damage to the environment. Colonies for the labourers should not be located in the CRZ area. It should also be ensured that the construction workers do not cut trees and mangroves for fuel wood purpose.

(4/6)

(viii) To prevent discharge of sewage and other liquid wastes in to the water bodies, adequate system for collection and treatment of the wastes must be provided. No sewage and other liquid wastes without treatment should be allowed to enter into the water bodies. The quality of treated effluents, emissions, solid wastes and noise levels must conform to the standards laid down by the competent authority including the Central/State Pollution Control Board.

(ix) Appropriate collection facility should be created for the solid and liquid wastes generated by the barges/vessels and their safe treatment and disposal should be ensured to avoid possible contamination of the water bodies.

(x) Necessary navigational aids such as channel markers should be provided to prevent accidents. Internationally recognized safety standards shall be applied in case of barge/vessel movements.

(xi) During operation phase proper precautions should be taken to avoid any oil spills and no oily wastes shall be discharged into the water bodies.

(xii) The project authorities should take appropriate community development and welfare measures for the villagers in the vicinity of the project site, including drinking water facilities. A separate fund should be allocated for this purpose.

(xiii) The quarrying material required for the construction purpose shall be obtained only from the approved quarries/borrow areas. Adequate safeguard measures shall be taken to ensure that the overburden and rocks at the quarry site does not find their way into water bodies.

(xiv) The maintenance dredging operations, if any required, should be executed with appropriate safeguard measures to prevent turbidity conditions in consultation with the expert agencies such CPWRS/NIO after obtaining prior approval of this Ministry.

(xv) For employing unskilled, semi-skilled and skilled workers for the project, preference shall be given to local people.

(xvi) To meet any emergency situation, appropriate fire-fighting system and water pipeline should be installed. Appropriate arrangements for uninterrupted power supply to the environment protection equipment and continuous water supply for the fire fighting system should be made.

(xvii) Regular drills should be conducted to check the effectiveness of the On-site Disaster Management Plan

(xviii) The recommendations made in the Environmental Management Plan and Disaster Management Plan, as contained in the EIA and Risk Analysis Reports of the project, shall be effectively implemented.

(516)

(xix) A separate Environment Management Cell with suitably qualified staff to carry out various environment related functions should be set up under the charge of a Senior Executive who will report directly to the Chief Executive of the Company.

(xx) The funds earmarked for environment protection measures should be maintained in a separate account and there should be no diversion of these funds for any other purpose. A year-wise expenditure on environmental safeguards should be reported to this Ministry.

(xxi) Full support should be extended to the officers of this Ministry's Regional Office at Bhopal and the officers of the Central and State Pollution Control Boards by the project proponents during their inspection for monitoring purposes, by furnishing full details and action plans including the action taken reports in respect of mitigative measures and other environmental protection activities.

(xxii) In case of deviation or alteration in the project including the implementing agency, a fresh reference should be made to this Ministry for modification in the clearance conditions or imposition of new ones for ensuring environmental protection. The project proponents should be responsible for implementing the suggested safeguard measures.

(xxiii) This Ministry reserve the right to revoke this clearance, if any of the conditions stipulated are not complied with to the satisfaction of this Ministry.

(xxiv) This Ministry or any other competent authority may stipulate any other additional conditions or modify the stipulated conditions, subsequently, if deemed necessary, for environmental protection, which shall be complied with.

(xxv) A copy of the clearance letter shall be marked to the concerned Panchayat/local NGO, if any, from whom any suggestion/representation has been received while processing the proposal.

(xxvi) State Pollution Control Board/Committee should display a copy of the clearance letter at the Regional Office, District Industries Center and Collector's Office/Tehsildar's Office for 30 days.

(xxvii) The project proponent should advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the Gujarat State Pollution Control Board and may also be seen at Website of the Ministry of Environment and Forests at http://www.envfor.nic.in/.

(xviii) The Project proponents should inform the Ministry as well as its Regional Office at Bhopal, the date of financial closure and final approval of the project by the concerned authorities and the date of start of Land Development Work.

(6/6)

The above mentioned stipulations will be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Hazardous Chemicals (Manufacture, Storage and Import) Rules, 1989, the Coastal Regulation Zone Notification, 1991 as amended in 1994 and July, 1997 and the Public Liability Insurance Act, 1991 and the Rules made thereunder from time to time. The project proponents should also ensure that the proposal complies with the provisions of the approved Coastal Zone Management Plan of Gujarat State and the Supreme Court's order dated 18th April, 1996 in the Writ Petition No. 664 of 1993 to the extent the same are applicable to this proposal.

(Dr. S.K. Aggarwal)
Additional Director

To

The Director,
Forests and Environment Department,
Block No. 14, 8th Floor,
Sachivalaya,
Gandhi Nagar -382 010,
Gujarat.

Copy to:

1. Managing Director, ESSAR Oil Limited, Khambhalia Port, PO Box 24, District Jamnagar 361 305, Gujarat.
2. Chief Conservator of Forests, Regional Office, Ministry of Environment & Forests, E-3/240, Arera Colony, Bhopal - 462 016.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 32.
4. The Chairman, Gujarat State Pollution Control Board, Sector 10 A, Gandhi Nagar, Gujarat 382043.
5. DIG (SU), Regional Office Cell, Ministry of Environment and Forests, New Delhi.
6. Guard File.
7. Monitoring Cell.
8. Sr. Adviser (H), Ministry of Environment & Forests, New Delhi.

(Dr S.K. Aggarwal)
Additional Director

No. FCA/WLP/29/ 1043-47 /2003-04
Office of the
Principal Chief Conservator of Forest,
Block No. 14/1, Old Sachivalaya,
Gujarat State, Gandhinagar.
Date : 27 /2/2004

To,
The Managing Director,
Essar Oil Co. Ltd.
Premchand House Annexe,
Ashram Road, Ahmedabad.

Sub: Proposal for right of way for laying of pipeline and construction of jetty etc. of M/s Essar Oil Ltd. near Vadinar passing through forest area/ Marine Sanctuary/ National Park at Jamnagar.

Ref:

(1) CF Jamnagar's letter No. A/LND/T-7/313 dated 2/6/95.
(2) Govt. of India letter No. 8C/12/385/96-FC dated 27/11/97.
(3) Govt. of India letter No. 8C/12/385/96-FCW dated 8/12/99.
(4) This office letter No. LND/29/A/1866 dated 30/9/97.
(5) Govt. of Gujarat letter No. FCA/1096/1663/K dated 16/10/97.
(6) Orders of Hon'ble Supreme Court in WP No. 9454-55/2001, Essar Oil Ltd. V/s Halar Utkarsh Samitee and Others, with SLP © No. 10008-11/01, 17694-17696/01, 17691-17693/2001 dated 19/1/2004.
(7) Govt. of India letter No. F.No. 11-14/2003-FC dated 12/3/2003.
(8) Govt. of India letter No. F No. 11-14/2003-FC dated 24/9/2003.
(9) Government of Gujarat letter No. WLP-112000-2093-G.1 dated 12/2/2004.

(1) A proposal for diversion of 15.49 ha of forest land for right of way (under Section 2 of Rule 4 of Forest Conservation Act, 1980) submitted by Essar Oil Co. Ltd. for laying submarine Crude Oil and discharge pipeline, product and RoRo/LoLo jetty and desalination plant etc. for its 9 mm. TPA Grass Root Refinery at Vadinar near Jamnagar was received through Conservator of Forests vide letter quoted at Sr. 1. above. The proposal was duly processed at various levels and was agreed in principle by Government of India vide its letter quoted at Sr. No. 2 above, subject to fulfillment of certain conditions and the same was finally approved by Government of India vide its letter quoted at Sr. No. 3 above after fulfillment of prescribed conditions.

(2) Also, a proposal for right of way requested by Essar-Gujarat was received through Conservator of Forests Jamnagar vide letter No. A/LND/24/T-7.2/2451/97-98 dated 19/9/97 for permitting Essar Oil Co. Ltd. to

install and establish the required Marine and On-shore facilities like laying of pipelines, product jetty, RoRo-LoLo jetty required for their petroleum refinery under the Wildlife Protection Act, 1972. The proposal was processed and submitted to the State Government vide letter quoted at Sr. No. 4 above for permitting the same under The Wildlife Protection Act, 1972. The State Government conveyed its permission vide letter quoted at Sr. No. 5 above subject to certain conditions.

(3) In the mean time the Hon'ble Gujarat High Court had restrained the State Government from giving any permission for laying oil pipeline etc in the MNP/Sanctuary area vide its orders dated 3rd August, 2000 in SCA No. 1778, 5476 and 5928/2000. The State Government as well as M/s, Essar Oil Ltd. had filed special leave petitions in the Hon'ble Supreme Court against the orders of High Court. In disposing off the said writ petitions filed by M/s Essar Oil Ltd and the State Government as mentioned at Sr. No. 6 above, the Hon'ble Supreme Court has given the following directions on 19/1/2004.

"As far as the appellant is concerned however, the way is now clear to proceed with the project in accordance with the permissions granted to it under the WPA,FCA and EPA. The State Government will issue the authorizations in the requisite format under sections 29 and 35 within a fortnight. We therefore, allow the appeals to the extent stated with no order as to costs."

(4) The State Government, having considered all the relevant facts, study reports and above mentioned orders of the Hon'ble Supreme Court and the observations made therein, is completely satisfied that permitting the Essar Oil Limited for laying of oil pipeline and construction of Jetty etc. in Marine Sanctuary and National park, Jamnagar will be in the overall interest of the Nation and protection as well as mitigating and improvement works are likely to benefit the marine life and that granting such permission will not be against the spirit of Wildlife (Protection) Act, 1972. The State Government vide letter quoted at Sr. No. 9 above, has formally authorised the Chief Wildlife Warden, Gujarat State, to permit M/s. Essar Oil Limited to lay its crude oil pipeline, construction of Jetty etc. as shown in their proposal in the above mentioned area, the break up of which is as follows.

Sr	Category	Ha.
1	Marine National Park	1.45
2	Marine Sanctuary	5.75
3	Section-20 (Reserve Forest)	8.29
		15.49

The land asked for the following purposes:

(i)	For laying of crude oil pipeline	8.70 ha
(ii)	For construction of jetty and Marine facility	6.79 ha
		15.49 ha

A copy of this order is enclosed herewith for ready reference. Having been authorised by the State Government, the permission is issued.

ORDER

Whereas the Government of Gujarat, having considered all ecological, environmental and legal aspects of the proposal of M/s Essar Oil Limited, and after complete satisfaction of the same has authorised the Chief Wildlife Warden, Gujarat vide their letter No: WLP-112000-2093-G.1 dated 12/2/2004 under Section-29 and 35(6) of the Wildlife (Protection) Act, 1972. to permit M/s Essar Oil Limited for laying of oil pipeline and construction of Jetty etc. in Marine Sanctuary and National park, Jamnagar.

And whereas the undersigned is authorised to issue such permit under Section-29 and 35(6) of Wildlife (Protection) Act, 1972, M/s Essar Oil Limited is hereby permitted to lay oil pipeline and construction of Jetty etc. in Marine Sanctuary and National park, Jamnagar in the area mentioned in para-4 above subject to the following conditions.

Conditions:-

1. The EOL must adhere to all the stipulated conditions suggested by the EIA study for minimizing and mitigating the damages caused to marine life mangroves, and the ecosystem while laying the pipeline.
2. The EOL shall contribute to the resources and funds for the up-keep and improvement of the Marine National Park and Sanctuary as per the norms and conditions to be decided by the Government of Gujarat for industries on and off the shore of Gulf of Kutch.
3. The ownership of the permitted land for right of way would remain that of the Government of Gujarat and the legal status of the land shall continue to be the Marine Sanctuary & Marine National Park / Forest Land.
4. The EOL shall actively participate in the oil spill contingency plan of different tires of contingency under the overall guidance and control of the Government of Gujarat and any coordinating agency specifically constituted for the same.
5. The EOL shall observe all the conditions stipulated while granting permission under the Forest (Conservation) Act, 1980 by the Government of India, including the compensatory afforestation of Mangroves and other types of plantations.
6. The EOL shall abide by all the conditions to be stipulated by the Government of Gujarat and the Chief Wildlife Warden cum Chief Conservator of Forests, Wildlife, Gujarat State from time to time for the conservation of the wildlife and marine biota and improvement of the Marine Sanctuary and the National Park in the Gulf of Kutch.
7. The flexible hoses should be periodically tested and in case of any deterioration of condition, the hoses should be replaced. The safety breakaway coupling should be provided in the system.

8. The Marine environment should be monitored every month for the water quality (temperature, petroleum hydrocarbons, phenols, sulphides, total organic carbon) sediment quality, primary productivity, benthos and biological parameters (primary productivity, benthos, fish quality and growth, bio-mass, phytoplankton and zooplankton).

9. A Disaster Management Plan should be prepared to take care of any oil leakage in the Gulf in consultation with the Coast Guards and the Marine Park Authority. The Oil Spill Contingency Plan should be drawn and adequate facilities be provided for combating the oil spill. These facilities should be monitored periodically.

10. Due to inclusion of corals in Schedule 1 of the Wildlife Protection Act the State Government sought a clarification from the Government of India regarding possible impact on the provisions of the CRZ notifications under the EP A as well as FCA. The Central Government by its letter dated 12th March'03 (quoted at Sr. No. 7 above) has clarified that the approvals already granted would not be affected by the amendment under the Wildlife Protection Act and that the applicant's project could proceed subject to the State Government's surveying the area for determining the density of corals and preparing a management plan which should include relocation of the corals coming in the way of the proposed pipeline. This survey is required to be done through an institution having expertise in the field and the funds for relocation and management of the corals should be made available by the EOL. An undertaking to this effect has been submitted by M/s. Essar Oil Ltd., on 29/1/04. The project proponents (EOL) should also formulate a Management Plan and provide adequate funds for its implementation for improvement of coral reefs and mangrove afforestation in the inter tidal region of Vadinar in consultation with the Marine Park authorities.

11. No discharge of crude oil washings should be done in the Gulf. In case any washing is done, adequate ballasting facilities with proper treatment should be provided. The pipeline should be maintained absolutely leak proof which should be verified by periodical intelligent pigging.

12. No dredging in the sea should be undertaken except where unavoidable during construction phase after providing full details and after obtaining the approval of Chief Wildlife Warden, Gujarat.

13. Over and above all the conditions imposed by the various authorities while granting permissions should be strictly adhered to by the EOL.

14. The EOL shall have to provide funds for all necessary steps to promote the conservation and development of flora and fauna in the region specifically Marine Sanctuary and Marine National Park.

15. Government of Gujarat may impose additional conditions as and when it becomes necessary for the preservation/conservation of flora/fauna and habitat of the marine life in the area.

16. N.I.O. Goa is being requested to survey the density of coral and prepare a management plan which should include relocation of corals coming in the way of proposed pipeline. The user agency (EOL) shall provide funds for the approved management plan in term of undertaking dated 29/1/2004 already submitted by Essar Oil Ltd. and undertake adequate safeguards and the works as provided in the plan while executing the project.

17. A monitoring report indicating compliance of conditions prescribed in various clearances shall be submitted by EOL to Conservator of Forests, Marine National Park, Jamnagar every six months.

(Pradeep Khanna)
Chief Conservator of Forest,
Wildlife and
Chief Wildlife Warden,
Government of Gujarat.
Gandhinagar.

Copy submitted to the Secretary, Ministry of Environment of Forest, Government of India, Paryavaran Bhavan, CGO Complex, New Delhi, with reference to their letter No. 8C/12/385/96-FCW dated 8/12/99, F No. 11-14/2003-FC dated 12/3//2003, and F No. 11-14/2003-FC dated 24/9/2003 for his kind information.

Copy submitted to the Principal Secretary, Forest and Environment Department, Government of Gujarat, Gandhinagar with reference to authorisation letter No: WLP-112000-2093-G.1 dated 12/2/2004 for favour of information.

Copy to the Conservator of Forests, Marine National Park, Jamnagar for information and necessary action.

Copy fd.w.cs. to Smt. Hemantika Wahi, Advocate Supreme Court 235, New Lawyers chambers, New Delhi 110011 for information.

Copy to Deputy Secretary (Environment), Forest & Environment Department, Sachivalaya, Gandhinagar.

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, Gandhinagar 382 010
Phone : (079) 23222425
(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

GPCB

No. PC/CCA-JMN-336 (19)/ ID-27398/ 464860 Date:- 06/08/2018

To,
M/s. NAYARA ENERGY LIMITED (27398)
PLOT NO: S NO.62-66....,
JAMNAGAR-OKHA HIGHWAY (SH-25) PO BOX NO.24,
VILL: VADINAR-361305,
TAL: KHAMBHALIA, DIST: DEVBHOOMI DWARKA.

Sub: Amendment of Consent to Establishment (NOC) of this Board under the provision the Water(Prevention and Control of Pollution) Act-1981, the air prevention and Control of Pollution) 1981 and the Hazardous Waste(Management and Handling) Rules 1989 & as amended up to year-2003 framed under the Environment (Protection) Act-1986..

Ref: -

1. The Board has issued Consent to Establishment (NOC) issued vide letter no. GPCB/CCA-JMN-366/5383, dated on 13/03/2009, which is further amended vide letter no. GPCB/CCA-JMN-366 (8)/ID-27398/205937, dated on 03/03/2014, Issued to M/s. ESSAR OIL LIMITED.
2. Your Letter Dated: 17/07/2018.

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 3(c) & 5(5) of the Hazardous Waste (Management, Handling and Trans boundary Movement) Rules-2008 & framed under the Environment (Protection) Act-1986, **The Board has granted CTE vide letter No.** GPCB/CCA-JMN-366/5383, dated on 13/03/2009, which is further amended vide letter no. GPCB/CCA-JMN-366 (8)/ID-27398/205937, dated on 03/03/2014, Issued to M/s. ESSAR OIL LIMITED**, valid up to 13/03/2019.** The Board has right to review and amend the conditions of the said consent.

The referred **CTE order issued dated 13.03.2009 and 03/03/2014** originally issued to **M/s. ESSAR OIL LIMITED** stand transferred to **M/s. NAYARA ENERGY LIMITED** with condition that **M/s. NAYARA ENERGY LIMITED** shall bind to comply with all the conditions subject to which it was granted as if consent was granted to **M/s. ESSAR OIL LIMITED** originally.

- The conditions of the Consent to Establishment (NOC) issued vide letter no. GPCB/CCA-JMN-366/5383, dated on 13/03/2009, which is further amended vide letter no. GPCB/CCA-JMN-366 (8)/ID-27398/205937, dated on 03/03/2014 and further amendments, Issued to M/s. ESSAR OIL LIMITED shall remain unchanged.

For and on behalf of
Gujarat Pollution Control Board

(P. U. Dave)
Environmental Engineer

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, Gandhinagar-382 021
Website : www.gpcb.gov.in

GPCB

AMENDMENT
No.: PC/CCA-JMN- 366(8)/ID 27398/ Date:

TO,
ESSAR OIL LTD,
ESSAR HOUSE,
OPP. GUJARAT COLLEGE,
ELLIS BRIDGE,
AHMEDABAD.

SUB : Correction in Extension of the validity of Consent to Establish (NOC) of the Board , letter issued vide No: PC/CCA-JMN- 366(8)/ID 27398/205937Dt: 03.03.2014.
REF: (1) Your letter reference no. EOL/ENV/27398/CTE Amendment/2015/498 dated 10.03.2015

Sir,
Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board had granted **Consent to Establish for** establishment of Crude Oil Refinery at **Sr.No. 62-66..., Jamnagar-Okha Highway, P.O.Box No.24, Vill: Vadinar, Tal: Khmbhaliya, Dist: Jamnagar** for the manufacturing of the items mentioned in the above referred order.

1. The CTE Order No. **PC/CCA-JMN-366/5383** date of issue: 13/03/2009 for operation of Industrial Plant for manufacturing the items/ products **mentioned in the** above referred **order is extended for further five years from the expiry of order no. PC/CCA-JMN-366/5383** issued on 13/03/2009.

2. All other conditions of the **PC/CCA-JMN-366/5383** date of issue: 13/03/2009, **issued to ESSAR OIL LTD** under various Environment Acts and Rules shall remain unchanged.

For and on behalf of
Gujarat Pollution Control Board

(Smt. U.K.Upadhyay)
Environment Engineer

Outward No:313362/07/05/2015

Clean Gujarat Green Gujarat
ISO - 9001 - 2008 & ISO - 14001 - 2004 Certified Organisation

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Paryavaran Bhavan
Sector-10-A, Gandhinagar - 382 010.
Fax : (079) 23232156
Website : www.gpcb.gov.in

NO: PC/CCA-JMN-366(4)/ 13800
TO,
M/S ESSAR OIL LIMITED,
PO BOX NO:24,
VILL: VADINAR.
POST: KHAMBHALIA.
DIST: JAMNAGAR.
PIN: 361305

= 4 JUL 2009

SUB: Amendment in CTE of the Board.
REF: CTE of unit vide this office letter no: PC/CCA-JMN-366/5383 dated 13/03/2009.

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 3(c) & 5(5) of the Hazardous Waste (Management and Handling) Rules'1989 & as amended up to year 2003 framed under the Environment (Protection) Act-1986,this order is served up to you for reviewing and amending the condition of the above referred CTE order as under.

(1) Product of sr.no:13 vize Phase wise production up to Power-780 MW in 'Product profile for refinery & petrochemical complex' is deleted.

(2) All other condition related to manufacturing of power is deleted.

(3) Separate CTE is bifurcated for manufacturing of power on the name of M/S Vadinar Power Company Limited.

(4) Following S.R.NO128,132,133 of village: Timbdi, 28,29/P,30,58,59,60,101, 103,104,105,106/P,107/1P,107/2,108/P,109,110,111,112 OF Village Kathi Devalia are deleted from the location of the original CTE.

(5) All other conditions of the above said order is remain same.

For and on behalf of
Gujarat Pollution Control Board
(R.V.PATEL)
Environmental Engineer

GUJARAT POLLUTION CONTROL BOARD
Paryavaran Bhavan
Sector-10-A, Gandhinagar - 382 010.
Fax : (079) 23232156
Website : www.gpcb.gov.in

Consent to Establish (NOC)

PNO: PC/CCA-JMN -366/ 5383 13 MAR 2009

To,
M/s. ESSAR OIL LTD.
(Refinery division)
PO BOX NO:24,Village: Vadinar,
Post: Khambhalia, Dist:Jamnagar
Pin:361 350

SUB: Consent to Establishment (NOC) under Section of Water and Section 21 of Air Act 1981.
REF: Your Application no: nil dated:23/06/2007 and consecutive Correspondence with this office.

Sir,

Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants Consent to Establish (NOC) for propose enhacement of crude refining capacity from present 9MMTA Capacity to 60 MMTA for the products tabulated below by a way of Debottlenecking and capacity maximization of the existing process units and augmentation with the new primary,secondary and the balancing processing units of integrated refinery cum petrochemical complex at survey no:62-66,77/2,88,97,286-297,299-310,312-323,363-366,368-377,378 p 1&2,379-381,534,56-61 etc of village Zankhar, Survey number 96 p,112-148,150-156,159 of village Timbdi,survey number 187-196,199-214,338,197,198,215-227,336 of village Kathi,Devalia, Survey number J-14,19,42,71,72 p,7-6p,16-18 etc of village Sodhani Targadhi,dist: Jamnagar in phase mmanner. The total cost of the project is 54918 crore and out of that 3125 crore are earmarked for EMS and total Area is 2330 Hector.

PRODUCT PROFILE FOR REFINERY& PETROCHEMICAL COMPLEX

Sr. no.	Product (REFIENERY)	Quantity (10.5MMTPA) PHASE-I	Quantity (32MMTPA) PHASE-II	Quantity (60MMTPA) PHASE-III
1	LPG	0.65 MMTPA	2.16 MMTPA	2.77MMTPA
2	ATF	0.4 MMTPA	2.50 MMTPA	3.70 MMTPA
3	HSD	4.81 MMTPA	17.15 MMTPA	20.98 MMTPA
4	PC NAPTHA	0.27 MMTPA	1.49 MMTPA	2.67 MMTPA
5	GASOLINE	1.85 MMTPA	9.75MMTPA	19.5 MMTPA
6	SULPUR	0.03 MMTPA	0.75 MMTPA	0.84 MMTPA

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7	COKE	0.94MMTPA	0.94 MMTPA	5 MMTPA
8	BITUMEN		0.6 MMTPA	0.38 MMTPA
9	SKO	0.76 MMTPA	0.4MMTPA	0.80MMTPA
10	FOMV2	3 MMTPA	0.5MMTPA	0.5MMTPA
11	Asphaltene Prills		1.0 MMTPA	
12	Clarified slurry		0.5MMTPA	1MMTPA
13	POWER	77MW	360MW	780MW

PRODUCT PROFILE FOR PETROCHEMICAL

SR NO	PRODUCT	CAPACITY In KTA
1	OXO ALCOHOLS	137+150
2	Phenol/Acetone/Bisphenol-A	200/120/150
3	PROPOLENE	1000
4	IPA	75
5	LLDPE-HDPE/HDPE	400/400
6	PP	650+550
7	Acrylic acid	160+80
8	Para xylene/PTA	800/600
9	LAB	200
10	Benzene	260
11	MTBE or ETBE	138 OR 152
12	Ethyl Benzene/Styrene	500
13	Styrene	39
14	Butadiene	180
15	Butene-1	55
16	MEG	700

SUBJECT TO THE FOLLOWING CONDITIONS:

The validity period of the order will be Five years from the date of issue

SPECIFIC CONDITIONS (* If the proposed project attracts EIA Notification &/ CRZ Rules):

1. **Applicant shall not start any construction activities without getting Environment Clearance Certificate from SEIAA/ MoEF under EIA Notification dated 14/09/2006.**
2. **Applicant shall comply with the all conditions stipulated by SEIAA/ MoEF in the order of Environment Clearance as and when issued.**
3. **Applicant shall obtain CRZ clearance from competent authority under CRZ Rules and all conditions of the same shall be complied with.**
4. **Applicant shall obtain The permission under FCA-1980 for the forest land from GOI**
5. **CTE of the board will get effect after the permission is accorded under FCA-1980 from GOI.**

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6 No any type of activities must be carried out in the Marine National park as well as sanctuary area prior to obtain FCA Clearance from GOI and CRZ Clearance.
7 Industry shall obtain prior permission of GMB for development of the proposed facilities and all condition of the same shall be compiled with.
8 Industry shall obtain prior permission of KPT for development of the proposed facilities, if applicable and all condition of the same shall be compiled with.
9 Industry shall not carry out any of the activity during the construction and operation phase in MNP/MS area.
10 Dredged material shall be disposed off at a place recommended/approved and in a manner prescribed by GMB/KPT such that there shall be no any environmental degradation.
11 Industry shall carry out all their activities during construction/operational phase such that there shall be no adverse impact on flora/fauna as well as existing mangroves after getting requisite permissions.
12 EMP and recommendation/suggestions given in EIA report shall be completely complied with.
13 Recommendation/suggestions given during environment public hearing shall be completely complied with.
14 All the conditions of the ECC bearing no:J. 11011/320/2006-IA-II(I) DTD.16/09/08.
15 Industry shall provide necessary protection measures in order to obviate any likely adverse effects on coastal erosion due to the project activities. The proponent shall commission a model study regarding impact of the jetty on coastal erosion through a reputed institute having experience in the field and prepare a time bound Environment Management Plan and incorporate the same as part of the project for implementation so that there is minimum infringement on the coast. Copy of the said plan shall be submitted to this board.
16 GPCB reserves the right to stipulate any other condition as and when required.
17 New reference shall be made to the competent authority(ies) and permission be obtained to carry additional effluent from the existing 52"dia.pipeline laid for existing 9MMTAA capacity refinery.
18 New reference shall be made to the competent authority(ies) and permission be obtained for handling increased quantity of crude etc from SPM-1 to crude Oil Tanks laid for existing 9 MMTPA Capacity refinery.
19 Industry shall obtained ISO 14001 &OSHAS 18000 certificate.
20 Applicant shall comply with provisions of all Environment Acts/Rules/Notifications along with their amendments from time to time & other guidelines issued/being issued by MoEF/CPCB/DoEF from time to time.
21 Applicant shall comply with guideline/orders/judgments etc issued/being issued of Hon'ble High Court/Hon'ble Supreme Court etc

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No ground water shall be used for the project coming under:
- Dark zone without permission of competent authority.
- Unit shall provide metering facility at the outlet of the ETP/unit

CONDITIONS UNDER THE WATER ACT 1974:

1 The total quantity of the industrial effluent from the manufacturing process and other ancillary industrial operations shall not exceed 21356M3/hr.
2 The quantity of the domestic waste water (Sewage) shall not exceed 200M3/hr.
3 Water intake from sea will be in a manner and from a point as per NIO recommendation. (i.e. Latitude 22° 29'.39"and Longitude 69° 39'.54"E)
4 For the treatment of the increased industrial waste water that will be generated due to proposed debottlenecking,expansion and modernization project following units of ETP shall be installed.
I- Primary Treatment system is consisting of oil removal systems like tilted Plate Intercepter and oil skimmers and secondary Oil Seperation system is consisting of separator/splitter basin and floatation unit.
II- Secondary biological treatment system consisting of two stage biological treatment system.
III-Tertiary treatment system consisting of Pressure sand filter and Activated carbon filter.
The above treated waste water is reuse for fire water,service water,irrigation water etc.
IV-Treatment system for Salt waste water from crude storage area and desalter water from CDU is consisting of floatation feed pit and DAF,Ph adjustment tank,flash mixer, flocculation tank and floatation tank ,Pressure sand filter.
5 The quality of the industrial effluent shall conform to the following standards

PARAMETERS	Permissible limits	Quantum kg/1000 ton crude processed
PH	6.5 to 8.5	
Fluoride(as F)	1.5mg/l	
Suspended Solids	20mg/l	14KG
Oil and Grease	10mg/l	7KG
BOD(3 Days at 27°C)	15mg/l	10.5KG
COD	50mg/l	
Sulphide(as S)	0.5 mg/l	0.35KG
Ammonical Nitrogen	50mg/l	
Cyanide	0.2 mg/l	
Phenol(as C6H5OH)	1mg/l	0.7KG

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* All efforts shall be made to remove colour & unpleasant odour as far as practicable.

6 (I) The treated industrial effluent conforming to the following standards shall be Sent to deep sea in a manner and at a point as per NIO recommendation. (i.e. Latitude 22° 29.39"and Longitude 69° 39.54"E) through 7(seven) port diffuser at a level just below CD

(II) The applicant shall produce a certificate from NIO before starting Production Indicating clearly that the disposal arrangement made by the industry is strictly as per their suggestion indicating longitude & latitude.

7. The entire quantity of the domestic waste water (sewage) of 200 m3/hr shall be treated in well-designed STP & conform to the following standards and utilized on land for irrigation / plantation.

PARAMETER	PERMISSIBLE LIMIT
BOD	Less than 20 mg/l
Suspended Solids	Less than 30 mg/l
Residual chlorine	minimum 0.5 ppm

8. The unit shall install meters for measuring category wise (Category as given in water – Cess Act-1977 schedule II) consumption of water.

CONDITIONS UNDER THE AIR ACT 1981:

1 New stacks for the proposed debottlenecking,expansion and modernization project shal be as per Annexure-A,B and C attached here with.

2 The ratio of fuel oil and fuel gas will be 7310Million Kcal/HR Will be used fuel.

3 The flue gas emission from the various stacks attached to the boiler/furnace/heater shall conform to the following standards.

PARAMETERS	PERMISSIBLE LIMIT
Particulate Matter	100 mg/NM3
Oxides of Sulphur	100 ppm
Oxides of Nitrogen	50 ppm

4. Process emission from the following units shall conform to the following standers.

Stack attached to	Parameters	Permissible limit

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FCC regenerator	Particulate Matter SO2 NOX HC	150mg/Nm3 2.5 kg/Ton of feed 25mg/nm3 15mg/nm3
FCC Feed Heater	Particulate Matter SO2 NOX HC	150mg/Nm3 2.5 kg/Ton of feed 25mg/nm3 15mg/nm3
SRU	Particular Matter SO2 NOX HC	150mg/Nm3 120 kg/Ton of feed 25mg/nm3 15mg/nm3

5. Concentration of SO2 in the gaseous emission from following process shall conform to the following standards.

Process	Emission limit
Distillation(Atmospheric plus vaccum	0.25 kg/tone of feed
Catalytic Cracker	2.5 kg/tone of feed
Sulphur Recovery unit	120 kg/tone of feed.

6. Sulfur Recovery units shall be attached to FCC,CDU/VDU,NHT,DHDS and flue gas Desulphurization shall be attached to FCC & Power plant.

➢ **Unit shall take all measures as per EIA Report.**

7. Stack monitoring facilities like porthole , platform/ladder etc. shall be provided with stacks/vents chimney in order to facilitate sampling of gases being emitted into the atmosphere..

8 Ambient air quality within the premises of the industry shall conform to the following standerds conform to the following standards: -

PARAMETERS	**PERMISSIBLE LIMIT**
Suspended Particulate Matter	200 Microgram/M3
RSPM	100 Microgram/M3
Oxides of Sulphur	80 Microgram/M3
Oxides of Nitrogen	80 Microgram/M3
Carbon Monoxide	5000 Microgram/M3
Hydrocarbon as CH4	160 Microgram/M3

9. All measures for the control of environment pollution shall be provided before Commencing production.

10 Industry shall vent all flammable gases through suitably designed flares.

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CONDITIONS UNDER THE HAZARDOUS WASTE(MH & TBM) Rules-2008:

1 The applicant shall provide temporary storage facilities for each tipe of Haz Waste asper Hazardous Waste (Management, Handling and transboundary movement) Rules, 2008 as amended from time to time.
2. The applicant shall be obtain membership of common TSDF site for disposal Haz. waste as categorized in Hazardous Waste (Managemen,Handling and transboundary movement) Rules, 2008 as amended from time to time.
3. The applicant shall obtained membership of common Haz Waste incinerator for disposal of incinerable waste.
4. Hazardous Waste generated shall be disposed off in accordance with the Hazardous Waste (Management, Handling and transboundary movement) Rules, 2008 and unit shall have to obtain authorization of the Board for all applicable categories of Hazardous wastes.
   (a) Used oil / spent oil shall be disposed off by selling it to registered re-refiner units only.
   (b) Oily sludge from separators shall be dispose of selling it to registered re-refiners unit only.
   (c) ETP sludge shall be disposed of at TSDF approved by the Board.
   (d) Used batteries shall be sold to the GPCB authorized dealers.
5. The applicant shall have to comply with the protocol for the TSDF and shall also have to comply with the honorable supreme court's Order in WP No.657 of 1995 dt. 14th oct. 2003 .Hon'ble supreme Courts monitoring committee's directives issued from time to time

GENERAL CONDITION:

Unit shall develop green belt within premises as per the cpcp guidelines. However, if the adequate land is not available with in premises, unit shall tie up with local agencies like gram panchayat, school,social forestry office etc. for the plantation at suitable open land in nearby locality and submit an action plan of plantation for next three years to the GPCB.

Plantation should be started along with constitution activity. For plantations within the premises, a spacing of at least 4mx4m shall be kept i.e to say 250 plants per acre shall be planted. For plantations outside the premises a spacing of 2mx2m will be kept.i.e. to say 1000 plants per acre.

1. Adequate plantation shall be carried out all along the periphery of the industrial premises in such a way that the density of plantation is atleast 1000 trees per acre of land and a green belt of **10** meters width is developed.
2. The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the Water Cess Act- 1977.

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18. Applicant shall have to comply with all the suggestions / Recommendations of the Environmental Public Hearing, enumerated in REIA report, enumerated in marine EIA.
19. Applicant shall have to submit copy of approval of chief Controller of Explosives for storage and handling, if applicable, up dated disaster management plan along with on site and off site emergency plan and other guidelines issued / being issued by MoEF/CPCB/DoEF from time to time.
20. Applicant shall have to carry out mock drill both on site and off site for all the possible eventualities at a regular interval off time. For any of the disastrous situations, escape route shall have to be predefined, properly marked and shall be brought to the knowledge of the concerned.
21. Applicant shall have to obtain the ISO 14001 & OSHAS 18000 certification and shall have to implement the suggestion / recommendations of the same.
22. Applicant shall have to implement EMP as stated in the REIA Report before the commencement of the production.
23. Applicant shall comply with the Forest (conservation) act 1980 and Rules 1981, CRZ notification and all Environmental Acts/Rules/Notifications and their amendments from time to time which ever each applicable.

24. G.P.C.B. reserves the right to stipulate additional condition if found necessary. The Company will implement these conditions in a time bound manner.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(R.V. PATEL)
ENVIRONMENTAL ENGINEER

COPY TO : M/s. ESSAR OIL LTD.
(Refinery division)
PO BOX NO:24,Village: Vadinar,
Post: Khambhalia, Dist:Jamnagar
Pin:361 350

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Paryavaran Bhavan
Sector-10-A, Gandhinagar - 382 010.
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ANNEXURE-A

Stack Details & Emission Characteristcs of 10.5 MMTPA

Process Units	Stack height (m)	Stack Dia. (top) (m)	Flue Gas Temp (°K)
CDU, VDU, Merox	115	4.36	473
VBU	100	3.06	473
NHT	130	4.16	473
CCR			
FCC }	80	1.604	473
FCC Regen. }	81.3	3.25	338
DHDS }	70	2.3	463
SRU }	80	3.01	623
Boiler	100	4 flues of 2.55	483
		m. dia. Each	

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ANNEXURE-B

Stack Details & Emission Characteristcs of 32 MMTPA

Sr.No	Stacks	Stack ht. above grade level (m)	Stack Dia. (top) (m)	Exit Temp (°K)
a)	**Fired Heater Stacks**			
1	CDU1/VDU Heater	115	4.45	473
2	CDU2 Heater#1	60	2.39	473
3	CDU2 Heater#2	60	2.39	473
4	VDU2 Heater#1	60	1.66	473
5	VDU2 Heater#2	60	1.66	473
6	VBU Heaters	2.40	100	473
7	NHT1/CCR heaters	3.50	130	473
8	FCC heaters	80	1.60	473
9	Prime G+ HDS Furnace	50	0.38	473
10	DCC heater	60	1.18	473
11	VGOHT Heater	60	1.45	623
12	DHDS 1 Heater	70	2.30	473
13	DHDS 2 Heater	60	1.19	623
14	DHDT 1 Heater	60	1.12	623
15	DHDT 2 Heater	60	1.12	623
16	NHT 2 Heater#1	60	1.09	473
17	NHT 2 Heater#2	60	0.85	473
18	NHT 2 Heater#3	60	1.07	473
19	HCU - RG Htr. (1st & 2nd. Stage)	60	1.43	473
20	HCU - Frac Hetaers	60	2.87	473
21	Delayed Coker1 Heater#1	60	1.43	473
22	Delayed Coker1 Heater#2	60	1.43	477
23	Delayed Coker2 Heater#1	60	1.43	473
24	Delayed Coker2 Heater#2	60	1.43	473
25	Coker NHT Heater#1	60	1.14	473
26	Coker NHT Heater#2	60	0.89	473
27	Coker NHT Heater#3	60	1.13	473
28	HMU1 - (86TPD)	50	1.61	473
29	HMU2 (naptha feed),238 TPD	45	3.38	474
30	HMU3 (naptha feed),238 TPD	45	3.38	474
31	HMU4 (neptha feed), 238 TPD	45	3.38	474
32	HMU5 (naptha feed), 238 TPD	45	3.38	474
b)	**Power Plant Boilers**			

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Sr.No	Stacks	Stack ht. above grade level (m)	Stack Dia. (top) (m)	Exit Temp (°K)
33	Boiler 1	100	2.55	483
34	Boiler 2	100	2.55	483
35	Boiler 3	100	2.55	483
36	Boiler 4 (Standby)	100	2.55	483
37	Boiler 5	100	3.68	483
39	Boiler 7	100	3.68	483
40	Boiler 8	100	3.68	483
41	Boiler 9 (Standby)	100	3.68	483
c)	**Process Stacks**			
42	FCC Flue Gas Desulfuriser	81	3.25	473
43	DCC Flue Gas Desulfuriser	81	3.25	473
44	SRU 1 (220*2 TPD)	80	2.25	623
45	SRU 2 (220*2 TPD)	80	2.25	443
46	SRU 3 (220*2 TPD)	80	2.25	443
47	SRU 4 (220*2 TPD)	80	2.25	443
d)	**Petrochemical Stacks**			
48	Power Plant Boiler 1	42	3.54	403
49	Power Plant Boiler 2	42	3.54	403
50	Power Plant Boiler 3	42	3.54	403
51	PRU (cracker plant) Furnace 1	1.75	30	403
52	Cumene/Phenol (cracker plant) Furnace 2	1.75	30	403
53	Acrylic (Cracker plant Furnace 3	1.75	30	403
54	Oxo- Alcohol (Cracker plant) Furnace 4	1.75	30	403
55	Cracker Plant 3 Furnace 3	30	1.75	403
56	Cracker Plant 4 Furnace 4	30	1.75	403
57	Cracker Plant 5 Furnace 5	30	1.75	403
58	LAB	30	1.12	403
59	C- Black	30	0.63	403

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ANNEXURE-C

STACK DETAILS AND EMISSION CHARACTERISTICS OF 60 MMTPA
(ADDITIONAL 32 MMTPA)

Sr No	Stacks	Stack Ht Above grade level (m)	Stack Dia at top (m)	Exit Temp (° K)
	Fired heater stocks:			
60	CDU1/VDU Heater	115	4.45	473
61	CDU2 Heater #2	60	2.39	473
62	CDU2 Heater #2	60	2.39	473
63	VDU2 Heater #2	60	1.66	473
64	VDU2 Heater #2	60	1.66	473
65	VBU Heaters	2.40	100	473
66	NHT1 CCR Heaters	3.50	130	473
67	FCC Heaters	80	1.60	473
68	Prime G + HDS Furnace	50	0.38	473
69	DCC heater	60	1.18	473
70	VGOHT Heater	60	1.45	623
71	DHDS 1 Heater	70	2.30	473
72	DHDS 2 Heater	60	1.19	623
73	DHDT1 Heater	60	1.12	623
74	DHDT2 Heater	60	1.12	623
75	NH2 Heater #1	60	1.09	473
76	NH2 heater #2	60	0.85	473
77	NH2 Heater #3	60	1.07	473
78	HCU –RG Htr (1^{st} & 2^{nd} stage)	60	1.43	473
79	HCU –Frac Heaters	60	2.87	473
80	Delayed cocker 1(Heater#1)	60	1.43	473
81	Delayed cocker 1(Heater#2)	60	1.43	477
82	Delayed cocker 2(Heater#1)	60	1.43	473
83	Delayed cocker 2(Heater#2)	60	1.43	473
84	Cocker NHT Heater #1	60	1.14	473
85	Cocker NHT Heater #2	60	0.89	473
86	Cocker NHT Heater #3	60	1.13	473
87	HMU1- (86 TPD)	50	1.61	473
88	HMU2 Naphtha feed 238 TPD	45	3.38	474
89	HMU3 Naphtha feed 238 TPD	45	3.38	474
90	HMU4 Naphtha feed 238 TPD	45	3.38	474
91	HMU5 Naphtha feed 238 TPD	45	3.38	474
b	Power plant boilers			
92	Boiler1	100	2.55	483
93	Boiler2	100	2.55	483
94	Boiler3	100	2.55	483
95	Boiler4 (standby)	100	2.55	483

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96	Boiler5	100	3.68	483
97	Boiler6	100	3.68	483
98	Boiler7	100	3.68	483
99	Boiler8	100	3.68	483
100	Boiler9	100	3.68	483
C	Process stacks			
101	FCC Flue Gas desulfuriser	3.25	81	473
102	DCC Flue Gas desulfuriser	81	3.25	473
Sr No	Stacks	Stack Ht Above grade level (m)	Stack Dia at top (m)	Exit Temp (° K)
103	SRU 1 (220*2 TPD)	2.35	80	623
104	SRU 2 (220*2 TPD)	80	2.25	443
105	SRU 3(220*2 TPD)	80	2.25	443
106	SRU 4(220*2 TPD)	80	2.25	443
d	Petrochemical stacks)			
107	Power Plant Boiler 1	42	3.54	403
108	Power Plant Boiler 2	42	3.54	403
109	Power Plant Boiler 3	42	3.54	403
110	PRU cracker plant (Furnace 1	1.75	30	403
111	Cumene/phenol Cracker plant furnace 2	1.75	30	403
112	Acrylic (cracker plant furnace 3	1.75	30	403
113	Oxo alcohol (cracker plant furnace 4	1.75	30	403
114	Cracker plant 3 furnace 3	30	1.75	403
115	Cracker plant 3 furnace 4	30	1.75	403
116	Cracker plant 3 furnace 5	30	1.75	403
117	LAB	30	1.12	403
118	C Black	30	0.63	403

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(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

No. PC/CCA-JMN-336 (19)/ ID-27398/ 464858

Date:- 06/08/2018

To,
M/s. NAYARA ENERGY LIMITED (27398)
PLOT NO: S NO.62-66…..,
JAMNAGAR-OKHA HIGHWAY (SH-25) PO BOX NO.24,
VILL: VADINAR-361305,
TAL: KHAMBHALIA, DIST: DEVBHOOMI DWARKA.

Sub: Amendment of Consolidated Consent & Authorization (CCA) of this Board under the provision the Water(Prevention and Control of Pollution) Act-1981, the air prevention and Control of Pollution) 1981 and the Hazardous Waste(Management and Handling) Rules 1989 & as amended up to year-2003 framed under the Environment (Protection) Act-1986..

Ref: -

1. The Board has issued Consolidated Consent & Authorization (CCA) NO. **AWH-81987** vide letter no. GPCB/CCA-JMN-366 (17)/ID-27398/205937, dated on 26/05/2017, Issued to M/s. ESSAR OIL LIMITED.
2. Your Letter Dated: 17/07/2018.

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 3(c) & 5(5) of the Hazardous Waste (Management, Handling and Trans boundary Movement) Rules-2008 & framed under the Environment (Protection) Act-1986, **The Board has granted CCA vide order No. AWH-81987 issued vide this office letter No. GPCB/CCA-JMN-366 (17)/ID-27398/205937, dated on 26/05/2017, valid up to 16/09/2022.** The Board has right to review and amend the conditions of the said CCA.

The conditions of the referred **CCA NO. AWH-81987 issued dated 26/05/2017 vide letter no. GPCB/CCA-JMN-366 (17)/ID-27398/205937** originally issued to **M/s. ESSAR OIL LIMITED** stand transferred to **M/s. NAYARA ENERGY LIMITED** with condition that **M/s. NAYARA ENERGY LIMITED** shall bind to comply with all the conditions subject to which it was granted as if consent was granted to **M/s. ESSAR OIL LIMITED** originally.

- The conditions of the Consolidated Consent & Authorization (CCA) issued vide letter no. GPCB/CCA-JMN-366 (17)/ID-27398/205937, dated on 26/05/2017 shall remain unchanged.

For and on behalf of
Gujarat Pollution Control Board

06/08/18

(P. U. Dave)
Environmental Engineer

Copy to:

(1) M/s. ESSAR OIL LTD (REFINERY DIVISION) (27398), PLOT NO: S No.62-66…..,
Jamnagar-Okha Highway (Sh-25) Po Box No.24, Vill: Vadinar-361305, Tal: Khambhalia, Dist: Devbhoomi Dwarka. ----- For information.

GPCB

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, **Gandhinagar** 382 010
Phone : (079) 23222425
(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

NO: PC/CCA-JMN-366 (17)/ID-27398/ **Date:**

TO,
M/S. ESSAR OIL LTD. (REFINERY DIVISION) (27398),
PLOT NO: S.NO. 62-66.....,
JAMNAGAR-OKHA HIGHWAY (SH-25), PO BOX NO: 24,
VILL: VADINAR - 361305
TAL : KHAMBHALIA,DIST : DEVBHOOMI DWARKA,

SUB: Correction in renewal of the consolidated consent & Authorization of the Board.
REF: Your letter reference no: EOL/ENV/27398/CC&A Amendment/2016/646, 07/12/2016.

Sir,

With reference to the above subject and reference letter, typographic correction in consolidated consent and Authorization order no. **AWH-81987 date of Issue: 13/10/2016 is as under.**

The said CCA order is further Correction as below:

- **First paragraph is corrected as below:**

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 3(c) & 5(5) of the Hazardous and other Waste (Management, Trans boundary Movement) Rules'2016 framed under the Environment (Protection) Act-1986.

1. Condition No-1 of the said CCA order is read as below:

1. Consolidated Consent and Authorization order No.: AWH-81987 date of Issue: 13/10/2016.
The consents shall be valid up to **16/09/2022** for use of outlet for the discharge of trade effluent & emission due to operation of industrial plant for crude processing capacity 21 MMTPA for the following items/products.

Sr. NO.	Product	% yield For 21 MMTPA
1	LPG	3.4-5.4
2	Kero + ATF	0-8.6
3	Naphtha/ MS/ Gasoline	16-24.6
4	HSD	48.6-52.9
5	Furnace Oil / V.G.O.	0-22.9
6	Sulfur	1.4-1.7
7	Bitumen	0-3.4
8	Fuel & Loss	7.8-8.7
9	Pet Coke	9.1-12.9

Condition No-2 of the said CCA order is read as below:

2. CONDITIONS UNDER THE WATER ACT:

2.1. The Quantity of trade effluent from factory shall not exceed 25400 m³ / Day.

2.2. The Quantity of sewage from factory shall not exceed 405 m³ / Day.

Condition No-3 of the said CCA order is read as below:

3. CONDITIONS UNDER THE AIR ACT:

3.1 The following shall be used as fuel in boiler/furnace/DG set:

Sr. no.	Fuel Type	Fuel Consumption rate (T/hr.)
1.	Liquid Fuel(LCO/ GT FUEL/ IFO/ HSD/ LDO) / Fuel Gas	101 MT/ Hr

3.2.1(b) The following stacks attached to boiler/ furnace/ heater shall conform to the standards referred in conditions no. 4.2.1(a).

Outward No: 413519, 26/05/2017

Sr. No.	Stack attached to	Stack Dia. Meters	Stack Height. Meters
1	CDU/ VDU Heaters	5.7	130
2	CDU-II Heaters	3.5	100
3	NHT/ CCR Heaters	5.7	130
4	DHDS Heaters	2.4	70
5	FCC Feed Heater	3.7	110
6	HMU Furnace	1.1	30
7	HMU I & II	4.7	45
8	DCU Heater I, II & III	2.5	65
9	DHDT	2.8	60
10	VGOHT	3.1	60

3.2.2 Industry shall have to vent flammable gases through the following flares:

Sr. No.	Type of Flare	No. of flare stack	Flare Stack height in m
1	Hydrocarbon Base flare	1	100 m
2	Hydrocarbon Expansion flare	1	150 m
2	H2S flare	1	100 m
4	H2S Expansion flare	1	150 m
3	LPG flare	1	65 m

4. CONDITIONS UNDER THE HAZARDOUS AND OTHER WASTE (MANAGEMENT TRANSBOUNDARY MOVEMENT) RULES, 2016:

4.1 The authorization is granted for the following hazardous waste, its quantity and mode of handling & disposal:

Sr. No.	Waste	Schedule -I	Quantity per year	Mode of Handling & Disposal
1	Oily sludge from ETP	35.3	13000 MT	Collection, Storage and disposal to TSDF of SEPPL / **incineration/ actual users/ Co-processing in D.C.U**
2	Slop Oil	4.3	120000 MT	Collection, Storage and recycle within the plant
3	Oily Rags/Oil Contaminated cotton Waste	5.2	5000 MT	Collection, Storage, transportation and disposal for TSDF/incineration/ actual users
4	Used lubricating oil	5.1	300 MT	Collection, Storage, Transportation & Disposal by selling it to registered re-refiner units
5	Oily sludge and BSW/emulsion	4.1	5000 MT	Collection, Storage and disposal to TSDF/ Incineration /actual user, Co-processing, in DCU unit.
6	Spent Catalyst from Various units	4.2	8000 MT	Collection, Storage and disposal Transportation through actual user/ TSDF /Incineration
7	Contaminated cotton rags or other cleaning materials	33.2	155 MT	Collection, Storage and disposal Transportation through actual user/ TSDF /Incineration.
8	Discarded empty drums/ containers	33.1	100 MT	Collection, Storage transportation & Disposal by selling it to authorized registered decontamination facility/actual user only
9	Spent Resins Waste	35.2	15 MT	Collection, Storage, transportation and disposal to TSDF/Incineration/actual user

Outward No : 413519 , 26/05/2017

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10	Insulated copper wire scrap/copper with PVC sheathing cable	IV/7	200 MT	Collection storage and disposal by selling to registered recycler/ reprocessor / actual user.
11	Lead Acid Battery waste	--	10 Mt/Year	Collection, storage, transportation by selling to registered recycler/ actual user.
12	Expired Hazardous chemicals (Liquid/Solid)	II/ Class E-3	100 MT	Collection, storage, transportation disposal at TSDF Site/ Incineration/ actual user only
13	Spent Carbon (Solid)	36.2	200 MT	Collection, storage, transportation disposal at TSDF Site/ Incineration/ actual user / incineration in Power plant boiler.
14	E- Waste	--	20 MT	Collection, storage, transportation disposal through actual user /Registered recycler.
15	Waste Coke	II-Class,A 70	100 MT	Collection, storage, transportation disposal through actual user.
16	Spent Catalyst and Molecular Sieves	1.6	100 MT	Collection, storage, transportation disposal through actual user TSDF Site/ Incineration/

4.11 The occupier may store the hazardous waste for a period not exceeding 90 days and shall maintain the records of sale, transfer, storage, recycling and reprocessing of such waste and make these records available for inspection. GPCB may extend the said period under certain conditions specified in the Hazardous and other Wastes(Management and Transboundary Movement) Rules – 2016.

4.17 The generator, occupier, transporter and operator of the TSDF facility shall comply with the directives specified by MOEF, Govt. of India, under the Hazardous and other Wastes(Management and Transboundary Movement) Rules – 2016.

4.23 The transporter shall be given relevant information in Form -9(TREMCARD).

4.35 In case, of an accident or spillage of hazardous waste during transit report in Form-11 shall be made to GPCB, Gandhinagar with a copy to Regional Office.

4.43 In case of any accident, details of the same shall be submitted in Form – 11 to GPCB.

2. The rest of the conditions of the above referred CCA order shall remain unchanged. You are directed to comply with these conditions judiciously.

For and on behalf of
Gujarat Pollution Control Board

(R.V. Patel)
Senior Environmental Engineer

Outward No:413519 06/05/2017

GPCB

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector 10-A, Gandhinagar 382 010
Phone : (079) 23226295
Fax : (079) 23232156
Website : www.gpcb.gov.in

BY R.P.A.D.

In exercise of the power conferred under section – 25 of the Water (Prevention and Control of Pollution) Act – 1974, under Section – 21 of the Air (Prevention and Control of Pollution) Act – 1981 and Authorization under Section – 5 of the Hazardous Waste (Management, Handling & Trans boundary (Movement) Rules, 2008 framed under the Environment (Protection) Act – 1986

And whereas board has received Consolidated Consent application inward no. **111130** dated **07/08/2016** for the Renewal of Consolidated Consent and Authorization (CC & A) of this board under the provisions/rules of the aforesaid acts. Consents and Authorization are hereby granted as under:

CONSENT AND AUTHORIZATION:
(Under the provisions/ rules of the aforesaid Environment Acts)

To,
ESSAR OIL LIMITED
PO BOX NO.24,
VILLAGE – VADINAR
POST – KHAMBHALIYA,
DIST: JAMNAGAR, PIN – 361305

Consolidated Consent and Authorization order No. AWH-81987, Date of issue: 13/10/2016.

1. The Consolidated Consent and Authorization shall be valid up to **16/09/2022** for use of outlet of the discharge of the trade effluent & emission due to operation of industrial plant for Crude processing capacity 21MMTPA for the following items/products and to operate a facility for collection, storage, transportation, disposal at TSDF developed by M/s. GEPIL, Surat or SEPPL, Kutch.

Sr. NO.	Product	% yield For 14 MMTPA	% yield For 20 MMTPA
1	LPG	3.8 – 4.5	4.3 - 4.9
2	Kero + ATF	5.0 – 10.0	2.0 – 6.0
3	Naphtha/ MS/ Gasoline	17.0 – 19.0	16 - 19
4	HSD	40.0 – 45.0	42 - 47
5	Furnace Oil / V.G.O.	18.5 – 23.0	9 - 13
6	Sulfur	1.2 – 2.5	1.0 – 2.0
7	Bitumen	4.5 – 5.1	2.0 – 3.0
8	Fuel & Loss	5.7 – 6.5	7.0 - 7.8
9	Pet Coke	---	7.5 – 9.5

Specific conditions:

- **Industry shall have to comply with all the conditions stipulated in the Environment Clearance, CRZ clearance and approval of Wild Life Board.**
- **Applicant shall have to submit copy of approval of chief controller of Explosives for storage & handling: up dated disaster management plan along with on site & off site Emergency plans as well as periodical compliance report for 'CREP' action in respect of petroleum refinery & other guidelines/directives issued/ being issued / CPCB / DOEF / hon'ble court from time to time.**
- **Applicant shall have to carry out mock drill both on site and off site for all the possible eventualities at a regular interval of time. For any of the disastrous situations. Escape route shall have to be predefined, properly marked and shall be brought to the knowledge of the concerned.**
- **Applicant shall have to obtain the ISO 14001 : 2004 and ISO 18001 certification and shall have to implement the suggestion/recommendations of the same.**
- **Applicant shall to prepare and implement the special oil spill contingency plan.**
- **Applicant shall have to carry out the regular health check up of employee as well as of the nearby villages. For the medical services to all. Mobile van with medical facilities shall be provided.**

- **Applicant shall have to utilize low sulfur fuel as much as possible & also to install adequate storage facilities in order to minimize fugitive & air emission.**
- **Applicant shall have to provide continuous on line monitoring facilities for the monitoring of the different pollutants.**
- **Applicant shall comply with provision of the Forest (conservation 0 Act-1980 andf Rule- 1981. The Petroleum and Minerals (pipeline acquisition of right of user land) Act-1962. CRZ notification and all Environmental Acts/Rules/Notifications and their amendments from time to time.**
- **Applicant is also required to comply with the Manufacturing, storage and Import of Hazardous Chemicals rules- 1989 framed under the Environment (protection) Act-1986.**
- **GPCB reserves the right to stipulate additional conditions if found necessary. The company will implement these conditions in a time bound manner.**

2. **CONDITIONS UNDER THE WATER ACT:**

2.1 The Quantity of trade effluent from factory shall not exceed 25400 m^3 / Day.

2.2 The Quantity of sewage from factory shall not exceed 400 m^3 / Day.

2.3 TRADE EFFLUENT:

2.3.1 The quality of treated effluent as per GPCB norms:

Sr. No.	Parameters	Permissible Limit (mg/L except for pH)	Quantum limit in Kg/ 1000 MT of crude processed
1	pH	6-8.5	---
2	SS	20	8
3	O&G	5	2
4	Phenol	0.35	0.14
5	Sulphides	0.5	0.2
6	BOD (5days 20)	15	6
7	COD	125	50
8	Cyanides (as CN)	0.2	0.08
9	Ammonia (as N)	15	6
10	TKN	40	16
11	P	3	1.2
12	Cr(Hexavalent)	0.1	0.04
13	Cr(Total)	2	0.8
14	Pb	0.1	0.04
15	Hg	0.01	0.004
16	Zn	5	2
17	Ni	1	0.4
18	Cu	1	0.4
19	V	0.2	0.8
20	Benzene	0.1	0.04
21	Benzo (a)- Pyrene	0.2	0.08

2.3.2 The Refinery effluent conforming to the above standards shall be utilized for fresh water Cooling Tower, and Sea Water cooling tower make - up and remaining quantity shall be used for fire water make – up, horticulture, dust suppression so as to achieve 100% recycle. The quantity of trade effluent shall not exceed **25400** Kl/Day.

2.3.3 The total quantity of the cooling tower waste water, R.O. reject and desalination plant reject of **206496** Kl/Day shall be returned to sea via pipeline and shall be released through diffuser at a point 22^0 29' 39'' N;
69^0 39' 54'' E and in a manner recommended by NIO vide their letter bearing no. NIO/B-2007/ESSAR (Salaya) dt. 31/05/2007.

2.3.4 All the effluent treatment units shall be operated and maintained efficiently so that the treated effluent always conforms to the specifications referred in condition no. 3.3.1 above.

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2.3.5 Domestic effluent generated from part of refinery shall be treated in the biological sections of ETP. Domestic effluent from Jetty shall be treated separately to conform to the standard and discharged into the Jetty.

BOD (5 days 20degC)	<20 mg/l
SS	<30 mg/l
Residual Chlorine	Minimum 0.5 ppm

3. CONDITIONS UNDER THE AIR ACT:

3.1 The following shall be used as fuel in boiler/furnace/DG set:

Sr. no.	Fuel Type	Fuel Consumption rate (T/hr.)
1.	Liquid Fuel(LCO/ GT FUEL/ IFO/ HSD/ LDO) / Fuel Gas	96 MT/ Hr

3.2 The applicant shall install and operate air pollution control system in order to achieve norms prescribed below:

3.2.1 (a) The flue gas emission through stacks attached to Boiler/ Furnace/ Heater/ plant shall conform to the following standards:

Sr. No.	Parameter	Fuel Type	Permissible Limit
1	Sulphur Dioxide(SO2)	Gas	50 mg/ Nm^3
		Liquid	1700 mg/ Nm^3
2	Nitrogen Oxide(NOx)	Gas	350 mg/ Nm^3
		Liquid	450 mg/ Nm^3
3	Particulate Matter (PM)	Gas	10 mg/ Nm^3
		Liquid	100 mg/ Nm^3
4	Carbon Monoxide (CO)	Gas	150 mg/ Nm^3
		Liquid	200 mg/ Nm^3
5	Nickel & Vanadium(Ni + V)	Liquid	5 mg/ Nm^3
6	Hydrogen Sulphide (H2S) in Fuel Gas	Liquid/ Gas	150 mg/ Nm^3
7	Sulphur Content in Liquid Fuel, weight %	Liquid/ Gas	1

3.2.1(b) The following stacks attached to boiler/ furnace/ heater shall conform to the standards referred in conditions no. 4.2.1(a)

Sr. No.	Stack attached to	Stack Dia. Meters	Stack Height. Meters
1	CDU/ VDU Heaters	4.36	115
2	VBU Heaters	3.06	100
3	NHT/ CCR Heaters	4.16	130
4	DHDS Heaters	2.4	70
5	FCC Feed Heater	1.6	80
6	HMU Furnace	1.1	30

3.2.2 Industry shall have to vent flammable gases through the following flares:

Sr. No.	Type of Flare	No. of flare stack	Flare Stack height in m
1	Hydrocarbon flare	1	100 m
2	H2S flare		100 m
3	LPG flare	1	60 m

3.2.3 (a) The process emission through various stacks / vents of reactors, process, vessel shall conform to the following standards:

FCC Regenerator:

Sr. No.	Parameter	Hydro process FCC feed	Other than Hydro process FCC feed
1	Sulphur Dioxide(SO2)	500 mg/ Nm^3	1700 mg/ Nm^3
2	Nitrogen Oxide(NOx)	400 mg/ Nm^3	450 mg/ Nm^3
3	Particulate Matter (PM)	100 mg/ Nm^3	100 mg/ Nm^3

4	Carbon Monoxide (CO)	400 mg/ Nm^3	400 mg/ Nm^3
5	Nickel & Vanadium(Ni + V)	2 mg/ Nm^3	5 mg/ Nm^3
6	Opacity	30%	30 %

Sulphur Recovery Units:

Sr. No.	Parameter	Permissible Limit
1	Sulphur Recovery	98.7 %
2	H2S	15 mg/ Nm^3
3	Nitrogen Oxide(NOx)	350 mg/ Nm^3
4	Carbon Monoxide (CO)	150 mg/ Nm^3

3.2.4 (b) The following emission stacks/ vent of reactors, process and vessel shall conform to the standards referred in condition no. 4.2.4 (a)

Stack No.	Location of Stack	Stack attached to	Stack Height in meters
	FCC Complex		
1	FCC	FCC Regenerator	110
	Sulfur Complex		
2	SRU	SRU	80

3.2.5 The concentration of the parameters in the ambient air within the premises of the industry shall not exceed the limits specified in NATIONAL AMBIENT AIR QUALITY STANDARDS – E(P)A Seventh Amendment Rules – 2009 , as mentioned below,

Sr. No	**Pollutant**	**Time weighted average**	**Concentration in ambient air**
1.	Sulphur Dioxide(SO2) µg/ m^3	Annual 24 Hrs	50 80
2.	Nitrogen Dioxide(NO2) µg/ m^3	Annual 24 Hrs	40 80
3.	Particulate matter(size less than 10 ppm) or PM 10 µg/ m^3	Annual 24 Hrs	60 100
4.	Particulate matter(size less than 2.5 ppm) or PM 2.5 µg/ m^3	Annual 24 Hrs	40 60
5.	Carbon Monoxide (CO) mg/ Nm^3	8 Hrs 1 Hr	02 04
6.	Benzene (C6H6) µg/ m^3	Annual	05
7.	Benzo (a)Pyrene (BaP) particulate phase only, µg/ m^3	Annual	01

3.2.6 For all combustion processes either sulfur free or de-sulfurized fuel shall be used.

3.2.7 Low NOx burners and/or De NOx system shall be incorporated for controlling NO2 into atmosphere. The residual NOx emission shall be in such a way that it will be dispersed effectively before reaching ground level.

3.3 The application shall provide portholes, ladder, platform etc at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and for use of Board's staff. The chimney(s) vents attached to various sources of emission shall be designed by numbers such S-1, S-2 etc. and these shall be painted/displayed to facilitate identification.

3.4 The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75 dB (A) during day time and 70 dB

(A) during night time. Daytime is reckoned in between 6 a.m. and 10 p.m. and nighttime is reckoned between 10 p.m. and 6 a.m.

3.5 Industry shall have to comply with EIA Notification No – SO 1533(E) dated 14th Sept – 2006 and its amendment issued from time to time by Ministry of Environment and Forest Govt. of India, New Delhi. Industry shall comply all the conditions stipulated in obtained Environmental Clearance

3.6 The industry shall comply all conditions issued by Ministry of Environment and Forest, GOI, New Delhi in their environmental clearance issued time to time and any directions issued from time to time. Regular compliance of it shall be submitted half yearly to this Board.

3.7 The applicant shall also comply with all standards/ notes etc. mentioned under GSR 186(E) dt. 18/03/2008 issued viz. notes for effluent, emissions, FCC Regenerators, Sulfur Recovery Units as wells as standards/guidelines etc. under part c entitled fugitive emission, storage of volatile liquid: Benzene storage

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PARYAVARAN BHAVAN
Sector 10-A, Gandhinagar 382 010
Phone : (079) 23226295
Fax : (079) 23232156
Website : www.gpcb.gov.in
GPCB

solvent for lube-base oil production (furfural, MEK, Toluene and MIBK); standards for equipment leaks; emission standards for VOC from waste water collection and treatment. You are directed to comply these conditions judiciously and send reports about the action taken regularly to this office.

4. **CONDITIONS UNDER THE HAZARDOUS WASTE (MANAGEMENT, HANDLING AND TRANSBOUNDARY MOVEMENT) RULES, 2008:**

4.1 **The authorization is granted for the following hazardous waste, its quantity and mode of handling & disposal:**

Sr. No.	Waste	Schedule -I	Quantity per year	Mode of Handling & Disposal
1	Oily sludge from ETP	35.3	13000 MT	Collection, Storage and disposal to TSDF of SEPPL / Co-processing in cement industry (i.e. Ultra Tech Cement Ltd, Kovaya, Dist: Amareli.)
2	Slop Oil	4.3	40000 MT	Collection, Storage and recycle within the plant
3	Oily Rags/Oil Contaminated cotton Waste	5.2	100 MT	Collection, Storage and disposal for incineration at CHWIF of SEPP / Co-processing in cement industry (i.e. Ultra Tech Cement Ltd, Kovaya, Dist: Amareli.)
4	Used lubricating oil	5.1	300 KL	Collection, Storage, Transportation & Disposal by selling it to registered re-refiner units
5	Oily sludge and BSW	4.1	2000 MT	Collection, Storage and disposal to TSDF/ Incineration
6	Spent Catalyst from Various units	4.2	MT	1.Hazardous waste: After Characterization If waste is found hazardous, then the waste shall be Collected, Stored, Transported & Disposed to authorized recyclers/ Re processor located within & Outside of the state and also shall to be submit the Authorization of the Recipient at the time of each trade. 2.Non – Hazardous waste; After Characterization if waste is found Non – Hazardous, waste shall be disposed by selling to Registered Recyclers/Re processor within & Outside of the state and also shall to be submit the Authorization of the Recipient at the time of each trade.
7	Spent Clay	4.5	155 MT	Thoroughly purged and made hydrocarbon free then disposal in landfill site
8	Discarded empty drums/ containers	33.1	20000 Nos.	Collection, Storage & Disposal by selling it to authorized registered decontamination facility only
9	Spent Resins Waste	35.2	7 MT	Collection, Storage and disposal to TSDF
10	Electric and Electronic waste	B-1110	10 MT	Collection storage and disposal by selling to actual recycler/reprocessor.
11	Lead Acid Battery waste	Sh-4/17	5 Mt/Year	Collection, storage, transportation by selling to registered recycler.

12	Expired Hazardous chemicals (Liquid/ Solid)	Sh-II, Class E-3	100 MT	Collection, storage, transportation by selling to registered recycler or in to TSDF site of SEPPL for incineration.
13	Spent carbon (Solid)	Category 36.2 of schedule-I	100 MT	Incineration in VPCL's power plant boiler
14	Insulated copper wire scrap/copper with PVC sheathing cables (solid)	Schedule-IV Sr.No.7	200 MT	Sale to CPCB/SPCB registered recyclers
15	Waste Coke (Solid)	Class A-3010 Schedule-III	100 MT	Sale to CPCB /SPCB registered recyclers
16	Spent Catalyst and Molecular Sieves (Solid)	Schedule – I Sr.1.6	100 MT	Hazardous Waste After Characterization, if waste is found hazardous, then the waste shall be collected, stored, Transported & Disposed to authorized recyclers /Re processors located within & Outside of the state. Non-hazardous waste After Characterization, if waste is found Non-hazardous, then the waste shall be disposed by selling it to Traders/Recyclers/Re processor by open tendering procedure to the vendor located within & Outside of the state.

4.2 You shall keep complete records of the types, quantities and characteristics of hazardous waste and its management from collection to ultimate disposal.

4.3 Storage site will be prepared and maintained as follows:-

a. Storage site will have sufficient capacity for storage of solid hazardous waste impervious lining having four- side adequate boundary protection.
b. A leachate collection and drainage line at all storage sites shall be provided and connected to the inlet of Effluent treatment plant for treatment.
c. Additional precautions shall be taken to prevent surface runoff through waste body during monsoon.

4.4 Unit shall explore the possibilities of waste minimization, avoidance, reuse, recycling etc.and submit the complete plan for approval of GPCB.

4.5 The waste generator shall be totally responsible for collection, storage, transportation and ultimate disposal of the wastes generated.

4.6 Waste after required treatment shall be stored with due care that in no case any waste shall be released from this site into Environment causing surface water or underground water or soil pollution.

4.7 In no case above waste shall be disposed off on land, within or outside factory premises, sold out to traders/ dealers or transferred, without prior approval of the board.

4.8 At the storage site, "Hazardous waste storage site" & "Danger" signboards shall be provided with all safety devices

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4.9 Each type of waste shall be stored in a separate storage cell. In no case more than one waste shall be stored in one cell.

4.10 Post storage monitoring shall be regularly carried out and report of the same shall be submitted to GPCB

4.11 The occupier may store the hazardous waste for a period not exceeding 90 days and shall maintain the records of sale, transfer, storage, recycling and reprocessing of such waste and make these records available for inspection. GPCB may extend the said period under certain conditions specified in the Hazardous Wastes(Management, Handling and Transboundary Movement) Rules – 2008.

4.12 The storage area shall have appropriate containment system as described in Guideline prepared by M.O.E.F. Government of India.

4.13 During all above activities, due care shall be taken to avoid any leakage or release of hazardous waste into environment.

4.14 Preparation of containers it's total No. Map of storage site nearby activity etc. shall be maintained and submitted to GPCB.

4.15 Emergency plan shall be prepared for storage site of Hazardous waste and submitted to GPCB, Gandhinagar.

4.16 The generator shall not offer his hazardous waste to transportation and to disposal facilities that have not been authorized by Gujarat Pollution Control Board.

4.17 The generator, occupier, transporter and operator of the TSDF facility shall comply with the directives specified by MOEF, Govt. of India, under the Hazardous Waste(Management, Handling and Transboundary Movement) Rules- 2008

4.18 For transportation of waste the generator & transporter shall ensure that the hazardous wastes are collected and packed separately as per characteristic wise category wise in such type of suitable container that it does not react with the wastes.

4.19 During transportation container shall be closed from all the sides except at the time of removal of wastes.

4.20 Hazardous waste shall be packaged and labeled as per guidelines issued by Central Pollution Control Board from time to time.

4.21 Sludge shall be dewatered before packing into containers

4.22 Each container shall be inspected at least once in a week for any leakages or spillageproblem

4.23 The transporter shall be given relevant information in Form -11(TREMCARD).

4.24 Transporter driver and person handling Hazardous waste shall be trained and drivers shall be educated/ trained properly

4.25 A copy of TREMCARD shall be forwarded before operation carried out to the Gujarat Pollution Control Board, Gandhinagar

4.26 Transporter shall be given all safety devices like goggles, gloves, mask, fire extinguisher, gumboots etc.

4.27 Vehicles, which are proposed to be used for transportation, shall be registered under Motor Vehicle Act

4.28 During transportation activity packing material and containers shall be such that there shall be no significant chemical and galvanic reaction among any of the material in package.

4.29 Labeling and marking on containers of the Hazardous waste and whole transportation operation shall be as per Motor Vehicles Rules'89.

4.30 Due care shall be taken during transportation to avoid leakages or spillage.

4.31 Emergency plan shall be prepared for transportation activity.

4.32 Source of waste generation and final destination of disposal place shall be informed to GPCB, Regional Office in that Area.

4.33 Transporter shall dispose Hazardous waste only at authorized cell of notified disposal facility located at your own secured landfill site.

4.34 The transporter shall be responsible for taking appropriate steps to clean up spillage, which may occur during transit as specified in TREMCARD

4.35 In case, of an accident or spillage of hazardous waste during transit report in Form-14 shall be made to GPCB, Gandhinagar with a copy to Regional Office.

4.36 A contingency plan shall be prepared and made known to the transporter for emergency action.

4.37 The generator/occupier or operator of facility or transporter shall prepare a manifest and shall forward copy to each other and also to the Regional office of GPCB in such a way that one can assure that Hazardous Waste is properly transported and disposed.

4.38 The generator/an occupier/ operator of the facility or transporter shall prepare a manifest, which shall consist of six copies in different colors.

4.39 The color codes and the movement of the manifest shall be as per the guidelines prepared by MOEF, Government of India.

4.40 In case of any change in process, product, mode of management of any waste generated other than specified in the application and correspondence, the applicant shall approach to the board with fresh application and requisite fee.

4.41 The fresh application shall be made in Form 1 before expiry of authorization validity period.

4.42 Records of waste generation and its management shall be maintained in Form – 3 and annual return shall be submitted to GPCB in Form – 4.

4.43 In case of any accident, details of the same shall be submitted in Form – 14 to GPCB.

4.44 As per "Public liability Insurance Act – 91" company shall get Insurance policy, if applicable.

4.45 Empty drums and containers of toxic and hazards material shall be treated as per guideline blished for "management & handling of discarded containers". Records of the same shall be maintained and forwarded to GPCB regularly.

4.46 In no case any kind of solid waste shall be imported without prior approval of appropriate authority.

5 General Conditions:

5.1 Any change in personnel, equipment or working conditions as mentioned in the consents/form/order should immediately be intimate to this Board.

5.2 Applicant shall comply with the general conditions given in Annexure-1.

5.3 Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon'ble Supreme Court order in W.P. No. 657 of 1995 dated 14th October 2003.

5.4 Industry shall have to display on line data outside the main factory gate with regard to quantity and nature of Hazardous Chemicals being handled in the plant, including waste water and air emissions and solid hazardous waste generated within the factory premises.

5.5. The applicant shall have at his cost get samples of emission collected and analysed from an approved laboratory once in a month for the parameters indicated in the condition No.3 and 4 shall submit in duplicate the report there of to the Board by the 10th of the succeeding month. The applicant shall also maintain records of the analytical results properly and shall keep these records/charts open for inspection.

For and on behalf of
Gujarat Pollution Control Board

(R.V.Patel)
Sr. Environmental Engineer.

NO: GPCB/JMN-CCA-366(17)/ID-27398/ 375931 **DATE:** 17 - 11 - 2016

To,
ESSAR OIL LIMITED
PO BOX NO.24,
VILLAGE – VADINAR
POST – KHAMBHALIYA,
DIST: JAMNAGAR, PIN – 361305

सत्यमेव जयते

Directorate Industrial Safety & Health
Gujarat State

Registration No. 2/24121/2006
FIN. R11000032A

FORM NO. 4
(Prescribed under Rule 5)
License to work a factory

License No. 32
D.A. 17-Jun-2006

License is hereby granted to

Mr. C. MANOHARAN +8

For the premises known as

NAYARA ENERGY LIMITED

situated at

39. K.M. MILESTONE S.H.25 JAMNAGAR-KHAMBHALIYA HIGHWAY PO.VADINAR

TAL.JAM KHAMBHALIYA DIST.JAMNAGAR

Ta.: Jamnagar Dist.: Jamnagar

for use as a factory within the limits specified in the plan approved by the

Joint Director Industrial Safety and Health, Rajkot Region

vide No. 870 Date 30-Aug-2006 subject to provisions of the

Factories Act, 1948 and the Rules made thereunder.

The license is issued for:

- Maximum Number of workers to be employed on any day during the Year :**Above 5000**
- Maximum installed power in B.H.P. on any day during the year :**Above 5000**

The license is valid up to 31st December 2021.

Fees paid Rs. 50.00
Fees due Rs. 0.00
Excess Rs. 50.00
Place : Jamnagar
Date : 06-Jul-2018

DIRECTORATE INDUSTRIAL SAFETY & HEALTH GUJARAT STATE

Assistant Director
Industrial Safety and Health
Jamnagar

074606

Annexures 3

Process Details with Flow Diagrams

Part A

A. Process Details and Flow Diagrams for Existing Refinery

A.1 Crude Distillation Unit

Processing of crude begins with distillation operation in CDU. Crude oil enters the unit from the crude storage day tank (located in PIT area) at ambient temperature. Crude is preheated through a series of heat exchanger trains (namely PHT-1, PHT-2 and PHT-3) against various heat bearing streams like HVGO, Vacuum Residue etc. Hot Crude oil post PHT-1 is feed to desalter where salts and sediments are separated out under electrostatic field. Post Desalter crude passes through PHT-2 and enters in pre flash vessel, where lighter are removed and routed to crude column top section. Crude is then further heated in a series of exchangers in PHT-3 and then finally in a furnace. Hot crude is feed to a main crude fractionator column where distillates are separated based on boiling point differences. The complete Schematic Process diagram is given in **Fig. A.1**.

- Distillate cuts from crude column are Overhead Naphtha, Heavy Naphtha, Light and Heavy Kerosene, Light and Heavy Gas Oil and atmospheric residue.
- The overhead vapours and Naphtha are routed to the Saturated Gas Separation Unit (SGU) for stabilization of Naphtha and recovery of LPG.
- Atmospheric residue is sent as feed for vacuum unit.
- Remaining distillates are further processed in secondary/tertiary units to produce valuable products meeting all specified specification.

A.2 Vacuum Distillation Unit

Atmospheric residue from the crude column is pumped to the vacuum unit; where it is further heated in a furnace before routing it to vacuum column. Distillation process is enhanced by low pressure stripping steam in vacuum column. Vacuum is maintained in the column by means of ejector system comprising of steam jet ejectors, condensers and liquid ring pumps.

Vapours from the flash zone moves up against various packing sections where based on the boiling point - Vacuum distillate, LVGO, HVGO, HHVGO are collected at different levels and are withdrawn while column bottom being vacuum residue. Vacuum column overhead vapours are routed through two stage LP steam ejectors / condensers and vacuum pump system to hot well vessel. Condensed vacuum overhead vapours are

recovered as vacuum slop (diesel component) while un-condensed vapour is passed through seal vessel to vacuum unit furnace as a fuel.

Vacuum Distillate is either as feed for the DHDS unit or to storage/blending for producing HSD as shown in **Fig. A.2**.

- The LVGO & HVGO are routed to VGOMHC unit (VGO hydrotreater / mild hydrocracker) before sending it to FCC unit.
- HHVGO is routed either to DCU unit or to storage for bitumen production.
- Vacuum residue is routed to DCU unit as feed.

A.3 Saturated Gas Separation Unit

Off gas via off gas compressor & overhead naphtha from CDU / off gas from NHT-CCR Unit / off gas from CDU-II unit / wild naphtha from DHDS/DHDT/VGOMHC unit are routed to SGU unit for stabilization of Naphtha and recovery of LPG. The Complete process diagram is given in **Fig. A.3**.

- Off gas post scrubbing with amine is routed to Refinery fuel gas header.
- LPG post scrubbing with amine is routed to LPG Merichem unit.
- Stabilized naphtha is routed as feed for NHT.

A.4 Fluid Catalytic Cracker

- The function of the unit is catalytic cracking of mixtures of vacuum gas oils, vacuum residue .These feedstock crack into lower boiling, high value products, primarily LPG, gasoline and light cycle oil for diesel product blending after processing in DHDS and fuel oil blending. The unit also produces fuel gas and slurry oil which goes to fuel oil.
- As this unit is equipped with two regenerators, it has flexibility to handle both light and heavy feed. Complete process Diagram in shown in **Fig. A.4.**

A.5 Crude Distillation Unit – II

CDU-II is designed to process Mangala crude, and obtain major yields of Diesel, Vacuum Gas Oil (VGO) and Vacuum residue (VR). Major equipment's include Desalter, Crude and Vacuum Heaters and Crude and Vacuum Columns. Crude, after preheating in Heat exchangers, is desalted and sent to Crude Heater for further heating. From Heater, it goes to crude column where it is flashed, and column OVHD vapours are cooled to obtain Naphtha product as shown in **Fig. A.5 and Fig. A.6**. Side product includes Diesel (routed to DHDS/DHDT or blending), and column bottom is Atmospheric Residue (AR), which is heated in Vacuum Heater. Heated AR is processed under vacuum in column, and yields Vac. slop oil and Top VGO as Diesel cuts which are routed to DHDS / DHDT or storage. Bottom Heavy VGO goes to VGOMHC/FCCU for further processing. Bottom of the barrel product VR is routed as feed to DCU Unit and also utilize for FO blending.

A.6 Kerosene Treating Unit

Kerosene Treating Unit (KMU) is installed to reduce Mercaptans and moisture from light kerosene cut of CDU-1 unit, which is further utilize for producing Aviation Turbine Fuel \ Superior kerosene and sometimes in diesel product blending.

A.7 Gasoline Treating Unit

Similar to kerosene, Gasoline Merichem Treating Unit treats light and medium gasoline from FCC unit to remove Mercaptans for producing BS-III and BS-IV grades of gasoline.

A.8 LPG Treating Unit

There are two LPG Merichem Units: one for treating saturated LPG from CDU-1/CCR unit and other to treat unsaturated LPG from FCC/DCU unit. Unit helps in to remove Mercaptans from LPG before routing it finally to storage.

A.9 Continuous catalytic reformer /naphtha hydro-treater

This is an integrated block that handles the Naphtha from various units like CDU, CDU-II and FCCU. Naphtha is hydrotreated in NHT to remove impurities like sulphur, nitrogen etc. The hydrotreated naphtha is split into light and heavy and heavier portion is catalytically reformed in CCR to improve Octane number of gasoline as required for the production of various grades of gasoline. Catalyst contains Platinum. Coke deposited on the catalyst is continuously regenerated. The Complete Process diagram is given in **Fig. A.7.**

A.10 Diesel Hydrodesulfurisation Unit (DHDS)

The purpose of this unit is to hydrotreat a blend of gas oil, diesel oil and kerosene or LCO in order to produce a low sulphur content gas oil. Sulfur present in the feed components is converted to H_2S in presence of catalyst with hydrogen under pressure. Hydrogen consumed in this plant is produced by CCR and HMU-1 &2. Operation of this plant is vital for production of BS-III and BS-IV grades of Diesel.

DHDS reactor (970 MT) is one of the largest. The unit routinely produces below 50 ppm diesel.

Unit is also operated in block out mode to produce ATF for approximately 20 % of time. VGOMHC MP off gas is utilized for hydrogen consumption during ATF mode operation. The typical process diagram of DHDS unit is shown in **Fig. A.8**.

A.11 Mini Hydrogen Unit (MHU)

The unit is designed to fulfill the Hydrogen requirement of DHDS. The unit processes LPG as feedstock to produce 10,000 Nm^3/hr of Hydrogen of 99.9% purity. LPG is vaporized and used as feed & make up fuel. The HMU uses Steam-reforming technology as shown in **Fig. A.9**.

A.12 Sour Water Stripper Unit (SWS)

Sour Water Stripper Unit is designed to process sour water originating from Crude Distillation Unit (CDU), Vacuum Distillation Unit (VDU), Amine Wash and Regeneration Unit (ARU), Saturated Gas Separation Unit (SGU), CDU-II, Naphtha Hydrotreating Unit (NHT), Unsaturated Gas Separation Unit (UGS), Diesel Hydrodesulphurisation Unit (DHDS), Sulphur Recovery Unit (SRU) and partially Delayed Coker Unit (DCU) as shown by a typical process diagram in **Fig. A.10**.

Sour water from Base SRU, ARU, DHDS, NHT, DCU, CRU, CDU and VDU is collected in the collecting vessel. The collecting drum separates any Hydrocarbon liquid coming along with the streams and skims it in an internal vessel, which is pumped out to slop oil tank. The vapor phase is vented from collecting drum to acid gas relief headers. The Sour water clear of hydrocarbon is pumped out from the collecting drum into Sour Water Tank. This tank of capacity 6462 m^3, holds 24 hrs.

Surge of Sour water at normal flow rate: This tank ensures a constant and stable flow to the stripper. The tank is also equipped with three hard-piped slop oil skimming nozzle to remove any slop oil which is carried over from collecting drum. To ensure positive pressure inside the tank, Nitrogen gas blanketing is provided. Sour water tank is provided with over pressure protection in the form of PVRV.

A.13 Amine Wash and Regeneration Unit

ARU is designed to process sour gas loaded stream of Methyl Di-Ethanol Amine. The function of this unit is to collect the rich amine streams from different units and to remove H_2S and CO_2 from the amine and return the lean amine to the respective unit at the desired temperature level. A typical Amin wash and regeneration unit process is given in **Fig. A.11**.

A.14 Sulphur Recovery Unit (SRU)

The main objective of this process unit is to process H_2S gas from Sour Water Stripper Unit (SWS) and Amine Regeneration Unit (ARU) and convert it to elemental sulphur and thereby avoid pollution of the environment. A typical process diagram of sulphur recovery diagram is given in **Fig. A.12.**

A.15 Delayed Coker Unit (DCU)

The Delayed Coking Process is a thermal cracking process for upgrading heavy petroleum residues into lighter gaseous, liquid products and solid coke (green coke). The petroleum residue feedstock is heated in a specially designed heater to high temperature with a brief residence time. The thermal cracking reactions start in the heater coil sand are completed in coke drums (accumulator vessels with long residence time).

The thermal cracking reactions in the heater are carefully controlled to minimize coke build up in the heater coils. The solid product (Green Coke) is retained in the coke drums. Coke drum effluent vapour is quenched to arrest further cracking reactions and then fractionated into various distillate and light end products.

There are distinctive differences between feedstock's such as vacuum residues and the cyclic oils. Vacuum residues have low aromaticity, but high coking value. They retain most of the sulphur and metals occurring in the crude. The residues contain asphaltic compounds, which are large heterocyclic molecules (ring compounds of atoms of different elements -such as quinoline). On the other hand, the cyclic oils, such as decant oil and pyrolysis residues have a high concentration of polynuclear aromatics. They contain single structures mainly of 6-carbon aromatic rings. These are the precursors of the well-known hexagonal lattice structure, which give graphite its unique physical properties, especially electrical conductivity. A typical process diagram is given in **Fig. A.13**.

The Key Process Steps are as Follows.

- Heat residue to about 505 °C to 507 °C in Coker furnace.
- Transfer the hot residue to coke drum before it has formed coke.
- Fill the drum and allow the heavy tars to coke.
- Switch the drums on timed cycle (16 to 18 hours).
- De-coke the filled drum hydraulically.
- Recover the cut coke, crush and evacuate through belt conveyor.
- Reuse water to eliminate waste.
- Fractionate cracked products into gas, Coker naphtha, light Coker gas oil and heavy Coker gas oil.
- Further process fractionated products in downstream units.

A.16 Hydrogen Manufacturing Unit (HMU - 1)

The main process steps are the following:

- Feed Preparation
- Hydrogenation and desulphurization
- Adiabatic Pre-Reforming
- Tubular Steam Reforming
- Heat Exchange Reforming (HTER)
- Shift Conversion
- Hydrogen product purification by PSA
- Steam Production By Waste Heat Recovery
- Process Condensate Stripping

The plant is designed for operation with natural gas as the normal feed stock as shown in **Fig. A.14**. The plant also operates continuously at design capacity on saturated LPG, saturated refinery gas, hydrotreated naphtha or sweet stabilized

naphtha. Furthermore it able to operate of a 50:50 mixture of saturated LPG and hydrotreated naphtha at design capacity.

The fuel for the reformer furnace is normally off-gas from the PSA unit supplemented by natural gas. In the case of absence of natural gas as a fuel of reformer, the RFG, saturated LPG or a mixture hereof is replace the natural gas. In case of absence of off-gas from the PSA unit, process gas is used. Natural gas can be used in place of off-gas, but at reduced plant load.

A. Feed Preparation

The natural gas from battery limit is supplied to Hydrogenation and desulphurization section at a minimum pressure of 37.5 kg/cm^2 g. The feed is mixed with recycle Hydrogen from the Hydrogen recycle compressor, and preheated/evaporated by means of steam in the feed vaporizer. Further preheating is taking place in the steam heated feed Preheater.

B. Hydrogenation and Desulphurization

The feed contains some sulphur which is poisonous to the reforming catalyst. The feed also contains some chlorine which is poisonous to the MT Shift catalyst. Therefore, the mixture of preheated vaporised feed and Hydrogen is sent to the Hydrogenator, which contains the Topsoe Hydrogenation catalyst, TK-250. In the Hydrogenator all organic sulphur compounds are converted into H_2S. Furthermore olefins are converted to saturated hydrocarbons.

C. Adiabatic Pre-reforming of Higher Hydrocarbons

Steam is added to the process gas to reach a steam/carbon ratio of 2.5 at the inlet of the pre reformer. The mixture is heated in the pre-reformer feed preheat coil, which is placed in the reformer waste heat section. The process gas is then passed through the adiabatic pre-reformer, in which the higher hydrocarbons are converted before the gas enters the fired reformer, and the heat exchange reformer. The risk of carbon formation owing to the cracking of higher hydrocarbons in the fired reformer is eliminated, making it possible to operate at low S/C ratios.

D. Tubular Reformer

The tubular reformer is constructed as a furnace consisting of two chambers, each, chamber containing a single row of centrifugal cast catalyst tubes made of high-alloy steel 25/35 Cr & Ni containing Nb & Ti.

The main part (74-79%) of the process gas from the pre-reformer is sent to the tubular reformer after split off of the process gas going to the HTER. After preheating in the reformer feed preheat coil, the process gas is distributed from a header through hairpins and enters the top of the vertically mounted catalyst tubes. The gas leaves the tubes at the bottom and directly enters the refractory-lined cold collector. The cold collector is connected to the bottom of the HTER via a refractory lined transfer line. The tubes are heated by a number of burners arranged symmetrically in horizontal rows at several elevations in each side wall. This arrangement provides easy control for a

uniform temperature profile along the length of the catalyst tubes and thus ensures the optimal utilization of the high-alloy tubes.

Normally off-gases from the PSA unit are used as primary fuel for the reformer complemented by natural gas or alternatively by a mixture of saturated LPG and unsaturated RFG gas, Combustion air for the reformer burners is compressed by the combustion air blower, and is preheated in the air pre-heaters, before going to the re-former burners. The inlet/exit temperature of tubular reformer is approximately 620/915°C.

E. Heat Exchange Reformer (HTER)

Approximately 21-26% of the process gas coming from the pre-reformer is branched off and sent to the HTER. The inlet temperature to the HTER as well as the performance can be adjusted by quench with treated process condensate and addition of superheated steam.

The feed gas is led to the catalyst beds via a number of inlet pipes. The reformed gas leaves the bed at a temperature of approximately 800°C and with a residual methane content of approximately 13% vol. (dry).

The effluent from the tubular reformer enters the HTER in the bottom at a temperature of 915°C and is mixed with the effluent from the HTER catalyst bed. The resulting gas, now at a temperature of about 880°C, flows up through the annuli and is cooled by the gas flowing downwards in the catalyst bed and is thus providing the necessary heat for the endothermic reforming reactions as described above. The gas leaves the annuli and flows across the inlet pipes to the exit of the HTER and further through the refractory lined transfer line and enters the waste heater boiler at approximately 640°C. The final residual methane content after the reforming section is approximately 5.85% vol. (dry).

The refractory lined exit pipe from the HTER is routed to the process gas boiler. The inlet temperature of feed gas from the pre-reformer to the HTER is approximately 420°C.

F. Flue Gas Heat Recovery Section

Flue gas leaves the fired reformer near the top of the radiant chamber at around 1070°C. The flue gas passes via a flue gas collector to the flue gas heat recovery section where the sensible heat of the flue gas is utilized for:

- Preheating of reformer feed
- Preheating of pre-reformer feed
- Steam superheating
- Combustion air heating
- Steam generation

Temperature in the stack is about 140°C.

G. Process Gas Heat Recovery and Shift Conversion

Process gas leaving the reforming section is cooled in the process gas boiler, and the 1st boiler feed water preheater, before it enters the MT (medium temperature) shift converter.

After reforming, about 15-18% CO is present in the process gas on a dry basis. The MT shift converter, reduces the CO content of the gas to about 2% by means of the Topsoe's medium temperature shift catalysts, LK-811 and LK-812.

Furthermore the BFW temperature inlet the 1st BFW preheater, is kept above the max. Water dew point of the process gas, which is 168°C in order to avoid formation of water droplets in the gas. The gas is then cooled in the 2nd BFW preheater, and the 3rd BFW preheater.

Before purification in the PSA unit, an air cooler, and water cooler, further cool the gas, and process condensate is removed. A small part of the treated process condensate is used as process quench. The necessary pressure for the quench stations is provided by the process condensate pump.

H. Gas Purification by Pressure Swing Absorption (PSA)

The process gas contains about 24-28% impurities, mainly CO_2. The impurities are almost completely removed in the PSA unit. The purified Hydrogen stream is delivered to the Hydrogen product header, common for the Hydrogen units, at 45°C and 21 kg/cm^2 g. A small stream of Hydrogen is compressed by means of the common Hydrogen and mixed with the feed stream to maintain HCR ratio.

I. Steam Production

Steam is produced from boiler feed water, which is a mixture of BFW coming from battery limit at 52 kg/cm^2 g and treated process condensate. The boiler feed water is pre-heated in the exchangers.

Finally, the high pressure steam from the steam drum is superheated to 420°C. Part of the superheated steam is used for the process. The rest of the superheated steam is exported at a temperature of 400°C and a pressure of 38 kg/cm^{2}g. The temperature of the export steam is controlled by a quench station using import boiler feed water.

J. Condensate Stripper Section

Dissolved gases, methanol and ammonia are-stripped off by counter-current contact with steam; the steam from the top of stripper is mixed with process steam upstream the process gas/steam mix point before the process gas is routed to the pre-reformer.

Stripped condensate from stripper is cooled and pumped to the mixing point with import boiler feed water. The mixture of treated process condensate and import boiler feed water is used as boiler feed water in the unit.

K. Process Description of PSA System

The UOP Polybed PSA unit uses Pressure Swing Adsorption (PSA). Impurities are adsorbed at high pressure and then desorbed at low pressure. Internally this is a batch type process. However, battery limit flows, i.e., feed, product and off- gas are continuous.

A.17 Isomerization Unit (ISOM)

This process catalytically isomerizes pentanes, hexanes and mixtures of similar-range boiling hydrocarbons.

This reaction takes place in the presence of hydrogen, over a fixed bed of catalyst, and operating conditions that promote Isomerization and minimizes hydro cracking. (Moderate operating pressure, low temperature and low hydrogen partial pressure). Ideally, the catalyst would convert all the feed paraffin to the higher octane number branched structures. A typical process diagram is given in **Fig. A.15**.

A. Feed Pre-treatment (Naphtha):

The feed and hydrogen reaching the reactor need special care and have appropriate treatment facilities. Sulphur Guard Bed removes sulphur to protect Isomerization catalysts. This is an adsorber unit which uses the adsorbent ADS –11L. Adsorbent contains ZnO, Nickel & Copper oxide on alumina.

DIH side stream recycle joins to this treated effluent from Sulphur guard bed Feed Effluent Exchanger. This combined stream further goes to Feed Dryers to remove mainly the water, CO & CO_2. These two feed dryers are arranged in lead and lag. Drier exit is analyzed continuously for water, CO & CO_2.

The Naphtha feed stream, then goes to Feed Surge Drum to provide the constant naphtha feed flow and to provide enough surge volume for any upset. Charge pump then pumps feed to Penex reactors through series of exchangers.

B. Hydrogen Pre-treatment

The impurities in hydrogen need to be removed using Make up Gas (MUG) Treaters (131V- 014A/B). The adsorbents in treater are used to remove low concentrations of H_2O, H_2S, CO_2, mercaptans, sulfides, mercury, NH_3 etc. The removed CO & CO_2 are converted into methane and water at 232°C.

Methanator effluent stream after giving heat to hydrogen in Methanator Feed-Effluent Exchanger, is cooled and compressed by using a reciprocating Makeup Gas Compressor (31K-001A/S) to ~38 kg/cm^{2}g and routed through a discharge KOD to separate the liquid and gas in efficient manner using the mist eliminator. After cooling it is sent to makeup gas dryers for removal of moisture & CO_2 by adsorption.

C. Penex Reactor

The Hydrogen from make-up gas dryers is mixed with feed and goes to two Penex Reactors via Feed Effluent Exchangers, Cold Combined Feed Exchanger (31E-010) and Hot combined feed Exchanger (31E-011). After picking up the heat in these two exchangers, chloride (Per-chloro ethylene) is injected in this stream by Chloride

Injection Pump (31P-003 A/S). The combined feed is heated by MP steam in Charge Heater (31E-012) to 120 ˚C (SOR)/ 165 ˚C (EOR). The Isomerization reaction takes place in two Penex Reactors (31R-002 A/B), which are in series & operates in lead & lag positions.

D. Stabilizer & Deisohexaniser

The Penex reactor 31R-002 B effluent, after giving heat to feed in Reactors Feed Effluent Exchangers (31E-010) is sent to Stabilizer column 31C-001 for LPG removal. Stabilizer top temperature is maintained at ~65 ˚C and Pressure is 14.53 kg/cm^{2}g, whereas bottom temperature is 173 ˚C. Stabilizer overhead is cooled and goes to Stabilizer Receiver where vapour and liquid are separated out

Excess LPG-liquid from this drum is sent to LPG stripper column. The flow to this column is controlled by Stabilizer Receiver level control. Vapours from this drum pass through the stabilizer Net-Gas Chiller. LPG components are recovered by heat exchange with refrigerant in Stabilizer Net Gas Chiller. The net gas then gets heated in double-pipe heat exchanger and goes to Net-gas Scrubber for acid removal by caustic and water circulation. After washing the gas in Net gas scrubber, it is routed to fuel gas header.

Some heat available in stabilizer column bottoms stream is utilized in DIH side draw re-boiler (31E-019) and Feed Stabilizer-bottoms exchanger (31E-006) before entering the DIH column on tray # 25. The column separates the feed into three products as top, bottom and a side product. The top and bottoms streams are combined to form the product Isomerate (mainly C-5 component with ~88-89 Octane Rating), which is sent to refinery storage after cooling. The side-draw from tray # 70 is partially recycled through DIH Side Draw Reboiler and remaining is sent to Feed Cooler for recycling Methyl-pentanes/hexane components (mainly C-6 component). Heat input to DIH is via MP steam in DIH Re-boiler.

E. De-isopentanizer

The function of the DIP is to separate out Iso-pentanes from the feed. The De Isopentanizer column is designed to handle 116 tons/h of naphtha flow.

Operating Condition of DIP column

Pressure: 3.25 kg/cm^2 (g), Temperature 64/116 °C

The existing fresh feed pumps 31-P-001 A/S pump the feed to the De-Isopentanizer column (131-C-005) which separates Iso-pentanes from the feed. The bottoms of the DIP column is pumped by 131-P-024 A/S which after cooling by Side Stripper reboiler (131-E-026) is fed to the existing Feed stabilizer bottoms exchanger (131-E-006). Part of bottom fluid reboiled in DIP reboiler (131-E-028) where LP steam is used as boiling media.

A.18 Sulfur Recovery Unit-1 (SRU – 1)

Claus Section

Thermal Reaction Stage

The thermal stage consists of the main burner, reaction furnace, waste heat boiler and first sulphur condenser. In the main burner the sour gas feed is burnt sub-stoichiometrically (= shortage of oxygen) with air. One-third of the H_2S present in the sour gas feed is combusted in this way, whereas the several feed gas impurities such as ammonia and hydrocarbons, are burnt completely to carbon dioxide, nitrogen and water. The major part of the remaining two-thirds of H_2S is thermally converted into sulphur. This equilibrium reaction is called the Claus reaction. The characteristic feature of the Claus reaction is the 2: 1 ratio between H_2S and SO_2. This ratio is constant throughout the process and is obtained by proper combustion air control at the main burner. Some sulphur is directly formed in the main burner flame by the so-called auto-dissociation reaction of H_2S, and under formation of hydrogen.

Catalytic reaction stage

In the two downstream catalytic reaction stages the Claus equilibrium reaction is continued at lower temperature by means of a special catalyst:

A. Scot section

Catalytic Hydrogenation Stage

In the reduction reactor virtually all sulphur compounds present in the non-incinerated Claus tail gas are converted to H_2S by hydrogen (H_2) over a cobalt/molybdenum catalyst (on alumina support) at a reactor inlet temperature of 220 - 240°C.Carbon monoxide (CO), which is also present in the Claus tail gas, is equivalent to H_2, since it reacts with water vapour (H_2O) present in the Claus tail gas to give CO_2 and H_2. The reduction reactions proceed faster if CO is present, probably because of the CO reaction. Carbonyl sulphide (COS) and carbon disulphide (CS_2) present in the Claus tail gas are mainly hydrolysed. The concentrations of COS and CS_2 approach thermodynamic equilibrium values

Absorption Stage

The cooled reactor effluent is sent to an absorber especially designed to allow the selective absorption of the H_2S by 30 % wt. MDEA. The greater part (90-92%) of CO_2, which is also present in the gas, is not co-absorbed and leaves the absorber with the treated gas. The SCOT off-gas is incinerated in order to convert the remaining H_2S into SO_2 and to convert other combustibles, such as hydrogen, as well. The main overall reactions in the absorber are (R_3N denotes the selective solvent).

Regeneration Stage

The loaded MDEA (rich solvent) is routed to the regeneration section, in which the H_2S and CO_2 are stripped from the solvent by increasing the temperature.

B. Sulphur Degassing Section

The sulphur produced in the SRU contains about 300 ppm wt. H_2S, partly chemically bound as polysulfide (H_2Sx) and partly physically dissolved. To remove H_2S and H_2Sx from liquid sulfur, eliminating potential toxic and explosion hazard associated with handling, transport and storage of liquid sulphur, the 'Shell Sulphur Degassing Process' has been developed. Degassing by means of the Shell degassing process reduces the H_2S content to less than 10 ppm wt. Degassing is obtained by injecting air via spargers in the liquid sulphur, thereby partly stripping the dissolved H_2S from the sulphur and partly oxidizing it to elemental sulphur. Furthermore, the removal of H_2S from the sulphur promotes the decomposition of the polysulfide into H_2S and sulphur.

C. Incinerator Section

The tail gas resulting from the SCOT section (or in case of SCOT bypass, Claus tail gas) and vent gas from the sulphur degassing still contain traces of sulphur compounds. These sulphur compounds are oxidized in the incinerator at elevated temperatures. Complete process diagram is given in **Fig. A.16**.

A.19 Expansion Sour Water Stripper (SWS – 1)

Sour water from SRU-I, ARU-1, DHDS, VGOMHC, DHDT, DCU, CRU, CDU and VDU is collected in the collecting vessel. The collecting drum separates any Hydrocarbon liquid coming along with the streams and skims it in an internal vessel, which is pumped out to slop oil tank. The vapour phase is vented from collecting drum to acid gas relief headers. The Sour water clear of hydrocarbon is pumped out from the collecting drum into Sour Water Tank. This tank of capacity 6462 m^3, holds 24 hours surge of Sour water at normal flow rate. This tank ensures a constant and stable flow to the stripper. The tank is also equipped with three hard-piped slop oil skimming nozzle to remove any slop oil which is carried over from collecting drum. To ensure positive pressure inside the tank, Nitrogen gas blanketing is provided. Sour water tank is provided with over pressure protection in the form of PVRV.

The Sour water from the tank is pumped out using stripper feed pumps to Sour water stripper after preheated to 100 °C in stripper feed/bottom exchanger. There is a provision to take the excess sour water from the Phase II Sour water unit from its feed pump discharge to ahead of the feed / bottom heat exchanger. The feed enters the 7th tray of Sour water stripper. The stream from the bottom of the stripper goes through a stripper reboiler. The reboilers are heated up by de-superheated LP steam. The condensates from the reboilers are sent it to SRU unit.

The stripped water goes through the feed / bottom exchanger to exchange heat with feed and then cooled from 74 °C to 59 °C in the Stripped water air cooler, finally in the stripped water trim cooler from 59 °C to 40 °C by means of cooling water and sent to refinery stripped water usage. Excess stripped water is routed to ETP.

The liquid from the chimney tray of the stripper which is placed above the feed tray is drawn by circulating water pumps and put back on the top tray of the column, after cooling by air cooler to maintain the top temperature around 85 °C. The cooled recycle

stream provides necessary reflux for the column to achieve desired overhead vapor composition. The overhead product which is essentially H_2S rich acid gas is routed to SRU (150) and excess is sent to acid gas relief header through split range pressure controller, which controls the column top pressure at 1.24Kg/cm^2. The typical process diagram is given in **Fig. A.17**.

A.20 De-hydro Diesel Treater Unit (DHDT - 1)

The primary purpose of DHDT is to treat the diesel feedstock by catalytic reactions and upgrade it into a superior quality of Diesel as shown in process diagram in **Fig. A.18**. The unit was commissioned in March 2012 with 3.8 MMTPA capacity for ULSD (less than 10 ppmw diesel product sulphur) production and capability to produce diesel with cold flow properties. The unit was revamped to 4.36 MMTPA capacity in October-2015. Feed streams to unit consist of light coker gas oil (LCGO) and coker naphtha (CN) from delayed coker unit, CDU-1 diesel (Heavy Kerosene, Light Gas Oil and Vacuum Distillate), Heavy Gas Oil from (HGO) from CDU-1, CDU-2 diesel and Light Cycle Oil from FCCU. The unit comprises of following main sections:

A. Feed Section

Cold feed from gas blanketed storage passes through a coalescer to remove potential slug of water and joins with other straight run components supplied directly from units and light coker gas oil and coker naphtha from Delayed Coker Unit. Combined feed to the unit passes through an automatic backwash filter (138FT-001) to remove the foreign particles before going to the Feed Surge Drum (138V-002). The Feed Surge Drum is a vessel designed to provide surge volume to even out fluctuations in feed entering the unit due to small upsets in the upstream units.

Feed from the Feed Surge Drum enters the multistage high-head Charge Pump (138P-002A/S) where its pressure is raised to allow the feed to enter the Reactor circuit. Feed from Charge Pump is preheated in the preheat train exchangers. After preheating, the feed splits into four passes and is directed to the inlet of the Charge Heater (138F-001) where it joins with Recycle Gas which is also separately heated in Effluent-Recycle Gas Exchangers.

B. Reactor Circuit Section

Combine feed and Recycle Gas stream is heated in Charge Heater. Charge heater is designed to fire with fuel gas only. The feed and Recycle gas streams are then processed in the Reactor. Reactor contains different types of catalysts, chosen for their ability to adsorb metals in the feed and provide the proper level of desulfurization required to meet the specified diesel product properties. Reactor is a single vessel with four beds and three intermediate quench points. Quench is required due to the heat of reaction of desulfurization. Reactor effluent material is cooled by heat exchange with diesel Feed, Recycle Gas and Flash drum liquid and routed to the Separator (138V-004 through product condenser (138EA-001).

To prevent the formation of ammonium bisulfide salts in the air cooled condenser, wash water is constantly injected in the appropriate amount upstream of the product condenser. The Separator separates the Recycle gas stream from both the hydrocarbon liquid and sour water, which contains ammonia and hydrogen sulphide. Recycle gas from the Separator is cooled in the Recycle gas Cooler to condense liquids from the gas stream entering the Recycle gas Scrubber. Recycle gas from the cooler passes through Recycle gas Scrubber Knockout Drum (138V-006) to separate condensed liquid from the gas and the gas proceeds to the bottom of the Recycle gas Scrubber (138C-001).

The Recycle gas Scrubber uses amine (40% MDEA) to absorb most of the hydrogen sulphide from the Recycle gas stream. A vent line connects to the Recycle gas line at the outlet of the Recycle gas Scrubber. The line is normally non-flowing and its purpose is to provide a means of adjusting the purity of the Recycle gas. Makeup gas is combined with Recycle gas at the suction of the Recycle gas Compressor (138K-001). Compressed gas is routed to the heat exchange network and quench lines. Rich amine from the Recycle gas Scrubber is sent to Rich Amine Flash Drum at the VGO HDT.

C. Makeup Gas Section

Makeup gas from Hydrogen Manufacturing Unit (HMU) is compressed in a two stage compressor (138K-002A/B/S). Makeup gas compressor section also serves as a source of hydrogen supply to VGO Hydrotreater Unit (2nd stage discharge).Three MUG compressors are provided, two are normally running and one is standby. This will fulfil the makeup gas requirements of the VGO HDT & DHDT units. The makeup gas rate to the unit is controlled by the pressure controller at the Separator.

D. Separation Section

Liquid from the Separator is sent to the Flash Drum (138V-005) where vapour is separated. The purpose of the Flash Drum is to separate the vapour produced when the Separator liquid is let down in pressure. Sour water from the Flash Drum is routed to the Sour Water Stripper. Hydrocarbon liquid from the Flash Drum is heated in the Fractionator Bottoms – Flash Drum Liquid, Effluent - Flash Drum Liquid Cold, and Effluent – Flash Drum Liquid Hot exchangers, Feed Fractionator Bottom Exchanger and sent to tray No. 16 of the Stripper (138C-002).

E. Stripper Section

The purpose of the Stripper is to remove the hydrogen sulphide present in the flash drum liquids and thereby making the Product Fractionator Reboiler and Product Fractionator, H_2S free. MP steam is added at the bottom of the Stripper to strip hydrogen sulphide from the liquid leaving the column bottom. Overhead vapours from the Stripper are condensed by the air cooled Stripper condenser (138EA-007) and routed to the Stripper Receiver (138V-013). Corrosion Inhibitor injection facility is provided in the Stripper overhead line.

The Stripper Receiver separates the non-condensable vapour, hydrocarbon liquid and sour water. Stripper net off gas along with off gas from Stabilizer Receiver is routed to the LP Off Gas Scrubber located at the VGOMHC for Amine treating. Overhead liquid is partly refluxed back to the Stripper on top tray and rest is routed to Stabilizer column along with Unstabilized Naphtha from VGOMHC Unit through Stabilizer Feed Bottom Exchanger.

F. Product Fractionation Section:

Stripper bottoms liquid enters the Fractionator (138C-003) on tray no 18. The Fractionator separates the full range naphtha and diesel. The overhead vapours from the Fractionator are condensed in the air cooled Fractionator condenser (138EA-005). Liquid from the Fractionator Receiver (138V-012) is split; part being pumped to the Fractionator as reflux and the net liquid being pumped to the Naphtha Hydrotreater for additional processing after cooling it in Product Trim Cooler (138E-014).

Heat input to Fractionator is provided by Fractionator Reboiler which is designed to fire on both fuel gas and fuel oil. Desulfurized diesel product is withdrawn from the bottom of the Fractionator and cooled in Stripper Feed-Fractionator Bottom, Fractionator Feed-Stripper Bottom, Diesel Product-Stabilizer Reboiler, Fractionator Bottom-Flash Drum Liquid exchanger and finally in air cooled Product cooler (138EA-004) and water cooled Product Trim cooler (138E-013) before sending to storage.

G. Stabilizer Section

Feed to stabilizer is heated in feed/bottom exchanger (138E-020) after mixing with VGOMHC Unstabilized Naphtha. The mixed feed enters the Stabilizer (138C-002) on tray no 6. The overhead product will be off-gas and is routed to VGOMHC and then Fuel gas header after mixing with Off gas from stripper (138C-004). Bottom product will be stabilized naphtha which is cooled in Stabilizer Feed Bottom Exchanger (138E-020) and fin-fan cooler (138EA-101) followed by trim cooler (138E-023 A/B) before sending to NHT and Storage.

A.21 VGOMHC – 1 (VGOMHC Unit)

VGO MHC process is designed to upgrade the feed quality of downstream FCC unit thereby improving Yield & Quality of Products. The capacity of this unit (122,784 BPSD) warrants split of the feed into two parallel Reactor trains. Each train of this unit contains a 5-bed Reactor, Charge Heater and a set of heat exchanger train as shown in **Fig. A.19**. VGO MHC unit can be divided into following main sections.

Feed Section

Cold Sour VGO (HGO/VGO blend) from gas blanketed storage, Sour HGO/VGO blend from CDU/VDU unit and CGO from Delayed Coker unit combines and passes through an automatic backwash filter (137FT-001) to remove the foreign particles before going to the Feed surge drum (137V-002). The Feed surge drum is a vessel designed to provide surge volume to even out fluctuations in feed entering the unit due

to small upsets in the upstream units. Feed from the feed surge drum is pumped through two charge pumps (137P-002 A/B/S) operated in parallel (One for each Train) where its pressure is increased to 138.2 Kg/Cm^2 (g). Feed from each operating Charge Pumps is preheated to a temp of 282 °C (train "A" and train "B") by passing through the heat exchanger trains. After preheating, the feed splits into four passes and is directed to the inlet of the Charge Heater (137F-001A/B) where it joins with Recycle gas.

A. Reactor Circuit Section

Feed from the feed section (each train) combines with Recycle gas and is heated to reaction temperature of 342 °C in two parallel Charge heaters (137F-001A/B). Charge heaters are operated on fuel gas only. The feed and recycle gas are then processed in two parallel Reactors (137R-001A/B). Reactors contain different types of catalysts, chosen for their ability to adsorb metals in the feed and provide the proper level of desulphurization required to meet the specified diesel and FCC feed properties. Catalyst cycle length would vary from 24 to 36 months depending on the mode of operation of the unit. Each Reactor has five beds with four intermediate quench points. Quench is required to control the heat of reaction. Each Reactor effluent material is cooled in the exchangers and routed to the Hot Separator (137V-003).

The purpose of the Hot Separator is to remove the heavy material and send it hot to fractionation. To prevent the formation of ammonium disulphide salts in the air cooled condenser, water is constantly injected in the appropriate amount upstream of the Hot Separator Vapor condenser. Hot Separator vapour stream is cooled to the temperature of the Cold Separator (137V-006) in the Hot Separator Vapour condenser. The Cold Separator separates the Recycle gas stream from both the hydrocarbon liquid and sour water, which contains ammonia and hydrogen sulphide. Recycle gas from the Cold Separator is cooled in the Recycle gas Cooler. Recycle gas from the cooler passes through Recycle gas Knockout Drum (137V-008) where condensed hydrocarbon is being separated and proceeds to the bottom of the Recycle gas Scrubber (137C-001).

The Recycle gas Scrubber uses lean amine (40% MDEA) to absorb hydrogen sulfide in the Recycle gas stream. A vent line connected to the Recycle gas line at the outlet of the Recycle gas Scrubber. The line is normally non-flowing and its purpose is to provide a means of adjusting the purity of the Recycle gas. Makeup gas is added to the Recycle gas line at the Recycle gas Compressor Suction Drum (137V-020) and the Recycle gas is compressed and routed to both the trains.

B. Makeup Gas Section

Makeup gas is supplied from DHDT (Unit 138) Make up gas compressors 2nd stage discharge at a pressure of 86 Kg/cm^{2}g and a flow rate of 10.3 Tons/Hr. Two compressors is normally running and one is standby. The makeup gas rate to the unit is controlled by the pressure controller at the Cold Separator (137V-006).

C. Separation Section

Liquid from the Hot Separator (137V-003) is removed on level control. Power recovery turbine (PRT) (137PR-001) is installed on this stream to recover some power to

save on electric power used to run a Charge pump motor (train "B" pump is used for connection with power recovery turbine). The material then passes to the Hot Flash Drum (137V-004) where vapour that is generated as a result of the drop in pressure, is separated.

Vapour from the Hot Flash Drum is cooled and partially condensed in the Hot Flash Vapour Condenser, combines with liquid from the Cold Separator and is routed to the Cold Flash Drum. Cold Flash Drum (137V-007) off gas is treated in the MP off Gas Scrubber (137-C-006) prior sending to the hydrogen recovery/ Refinery Fuel Gas System. Hot Flash Drum liquid is routed directly to tray No. 8 of the Stripper (137C-002). Cold Flash Drum liquid is heated in the Hot Separator Vapour - Cold Flash Drum Liquid and delivered to tray No. 6 of the Stripper.

D. Stripper Section

The purpose of the Stripper (137C-002) is to remove the hydrogen sulphide present in the flash drum liquids and thereby making the Product fractionator feed heater (137F-002) and Product fractionator (137C-003) Hydrogen sulphide free. MP steam is added at the bottom of the Stripper to strip hydrogen sulphide from the liquid leaving the column bottom. Overhead vapours from the Stripper are condensed by the air cooled Stripper Condenser and water cooled Stripper Trim Condenser and routed to the Stripper Receiver (137V-013). Corrosion Inhibitor injection facility is provided in the Stripper overhead line.

The Stripper Receiver separates the non-condensable vapour heavily loaded with hydrogen sulphide; hydrocarbon liquid and sour water. Stripper net vapour is routed to the LP off Gas Scrubber (137C-007) for H_2S removal and subsequently used as a Fuel gas. Overhead liquid is refluxed back to the Stripper. There is normally 50.83 Tons/hr. overhead liquid from the Stripper; which is sent to Saturated Gas Plant (SGU-I) for further treatment during coker naphtha processing.

E. Product Fractionation Section

Stripper bottoms liquid is heated first in the Product Fractionator Feed - Bottoms exchanger, it is split into twelve passes and then heated to a temperature of 357 °C in the Product Fractionator Feed Heater and sent to the Product Fractionator (137C-003) on tray No. 45. Product Fractionator Heater is operated on Fuel Gas and Fuel Oil.

The Product Fractionator separates the full range naphtha, kerosene, diesel, and gas oil products present in the column feed. Desulfurized gas oil product is withdrawn from the bottom of the Product Fractionator and cooled in a series of exchangers, including Product Fractionator feed, fresh feed, and MP and LP Steam generators. The Sweet VGO product is then routed to the FCC-I unit. When FCC-I unit is not in operation, the Sweet VGO is cooled in the Product Fractionator Bottoms Cooler up to 85 °C and sent to storage.

F. Rich Amine Section

The Rich Amine system collects rich amine from the Recycle gas Scrubber (137C-001), LP and MP off Gas Scrubbers located in this unit as well as from DHDT (Unit 138) Recycle gas Scrubber. Rich amine from all high pressure users is sent to the Rich Amine Flash Drum (137V-009). Rich amine is sent to the Amine regeneration facilities.

Part B

B. Process Details of Proposed ADP-1 Project

Under the ADP-1 Project, only two process units; Propylene Recovery Unit and Polypropylene Unit of 450 KTPA Capacity shall be installed. The process details are briefly described here.

B.1 Propylene Recovery Unit (PRU)

In the PRU, Propylene molecule shall be recovered from Unsaturated LPG as Feed to Polypropylene unit. The purpose of this unit is to separate polymer grade propylene of 99.5 wt% purity from unsaturated LPG Streams originating from the refinery/ FCC and Delayed Coker unit. Unsaturated LPG Stream is basically a mixture of Propane, Propylene, C2s and C4s.

Sections of PRU*:*

- C3/C4 Splitter (Depropanizer)
- Deethanizer
- C3 Splitter
- Propylene Drier/Treater Section

B.1.1 C3/C4 Splitter

The LPG to the Propylene Recovery Unit (PRU) is first fed to the C3/C4 Splitter. This fractionates butanes and heavier components (C4+) from a mixture of lighter components (mixed C3 and C2's). The C4+ material from the bottom of the Splitter will be sent to refinery LPG pool.

The unsaturated LPG feed enters the C3/C4 Splitter column after being preheated with the C4+ material leaving the bottom of the column. There are typically two reboilers provided for C3/C4 Splitter. The first reboiler heat input is supplied by circulating hot oil or heat integration with upstream units (usually circulating stream from upstream FCC unit, such as LCO or heavy naphtha).

The second reboiler is an "auxiliary" steam reboiler. Steam reboiler is provided for flexibility in operations, especially during the start-ups and shutdowns. The heat input is controlled to provide enough vapor traffic up the tower so there is adequate reflux to give the desired C3-C4 separation. Reflux flow is controlled to hold a tray temperature stable near the top of the column. This will keep the composition of the overhead material (mixed C3) constant. The net overhead material is pumped to the Deethanizer to control the level in the overhead receiver. The C3/C4 Splitter bottoms material is C4 product which is sent to the refinery LPG pool.

B.1.2 Deethanizer Section

The overhead from C3/C4 Splitter is then sent to the Deethanizer column. Deethanizer fractionates ethane and lighter components (C2-) from a mixture of propylene and propane (mixed C3). The C2- material from the top of the Deethanizer is recycled to the Gas Concentration Unit.

The reflux drum is provided with a boot leg for draining any traces of water separated from the hydrocarbons. Deethanizer Column bottom product containing primarily C3s is sent on level control as feed to C3 splitter column for further separation.

B.1.3 C3 Splitter

Feed to the C3 Splitter is fractionated into propane and propylene. Propane is sent from the bottom of this column to refinery LPG pool and propylene from the overhead of the column is further treated downstream.

The overhead vapor from C3 Splitter flows into the flash drum called Compressor Suction Drum and on to a heat pump compressor and then to the C3 Splitter thermo siphon Reboilers. The overhead vapor is heated via the compression and is used to reboil the column. After cooling and condensing in the reboiler, the overhead material returns to the C3 Splitter by joining the reflux line as a liquid. Because most of the overhead material is condensed in the reboiler it is possible to eliminate the large overhead condenser needed for a conventional distillation tower. The flow of overhead material from the reboiler is controlled to provide enough vapor traffic up the tower so there is adequate reflux to give the desired separation of propylene from propane.

A spill back controller is provided which opens a bypass around the compressor if suction flow drops too low. This is set above the minimum design flow for the compressor to avoid surge.

The bottoms product is propane which is sent to the refinery LPG pool.

B.1.4 Propylene Drier/Treater Section

COS, H_2S, Arsine, Oxygenates and moisture impurities removal is undertaken by utilizing Adsorbent Beds. These adsorbent beds are filled with proprietary mixed bed adsorbents to effectively remove impurities and achieve Polymer grade Propylene Specs.

The Outlet Polymer grade propylene product purity from the beds is monitored using an online analyzer. The adsorbent beds are alternatively regenerated. The final polymer grade propylene product is sent to the Polypropylene Unit.

The Process flow diagram of the unit is given below in **Fig. B.1**.

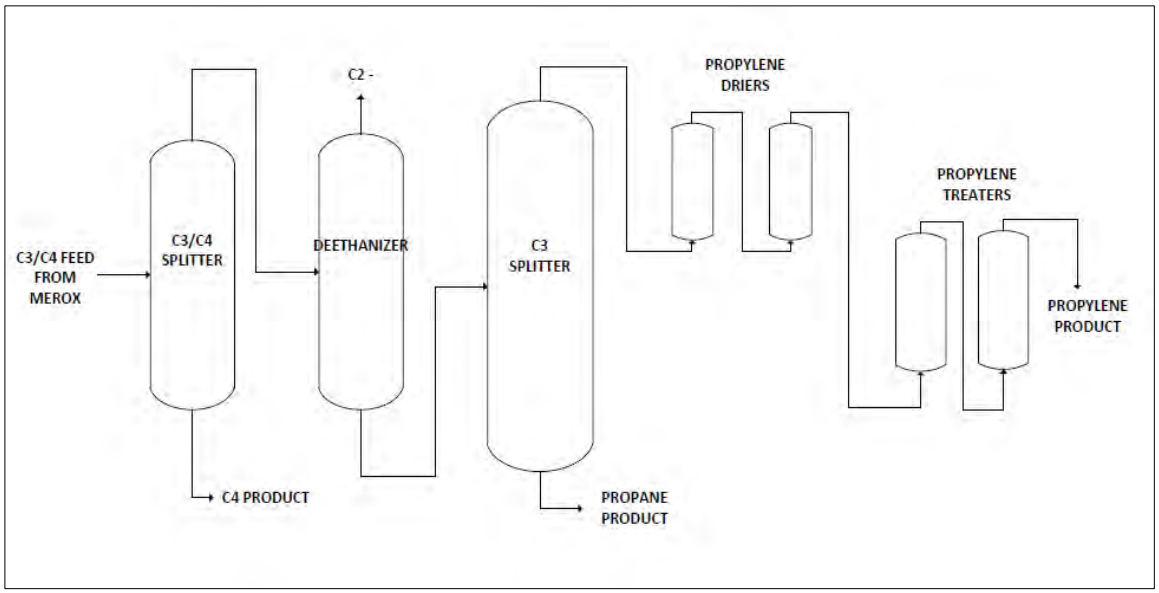

Fig. B.1: Process Flow Diagram of Propylene Recovery Unit

B.2 Polypropylene (PP) Unit

The main purpose of the proposed Polypropylene Unit would be to produce overall 450 KTA of pelleted polypropylene from propylene. PP process Unit includes the following systems:

- Raw Material Supply and Purification Area Facilities
- Propylene Purification
- Reactor – Rx 1 for making H/R products (includes catalyst handling and feeding)
- Reactor – Rx 2 for making Impact product
- Resin Degassing
- Vent Recovery
- Additive Addition
- Pelleting
- Pelleting Product Blending and Handling
- Product Transfer and Product Elutriator System, Product Loading Bins and Product Packaging (Bagging & Palletizing)

Gas phase Fluidized bed Technology PP process is state-of-the-art. At the same time, it is mechanically simple and easy to operate.

Propylene, hydrogen and Ethylene (if random or impact copolymer is made) from battery limit is passed through purification section and polishing them to make it suitable for processing in reaction system. The main catalyst, Co-catalyst T2 and stereo regulating agent (SCA) are transferred from their commercial containers to metering drum/ containers. From metering drums they are dosed in measured quantity to Reaction system.

Raw material (Propylene) and catalyst are reacted in reaction system for production of desired polypropylene. Reactors are Fluidized bed reactors. Reaction system has two reactors in series reactor-1 and reactor-2. Reactor-1 is used for manufacturing homopolymer and random co-polymer. Reactor -2 is used for preparation of Impact Co-polymers. During Impact co-polymer production the product produced is transferred to second reactor and then from there to resin degassing system. In case of Homopolymer and Random- copolymer it is directly transferred to Resin degassing from Reactor-1.

In resin degassing section unreacted monomer goes to monomer recovery section. Recovered monomer is recycled back to reactor 1 / reactor -2 depending upon kind of polymer (homo, random or impact) produced. The resin produced (Polypropylene granules /Powder) is then passed through the additive section. Where additives are added for resin stabilization.

After adding desired additives to resin, it is passed through an extruder / pelleting section for proper additive mixing and pelletizing to get desired final product i.e. PP pellets. PP pellets are then conveyed to storage silos and after blending in storage silos, transferred to bagging section for packaging and selling. The block flow diagram of Polypropylene Plant is given below in **Fig. B.2**.

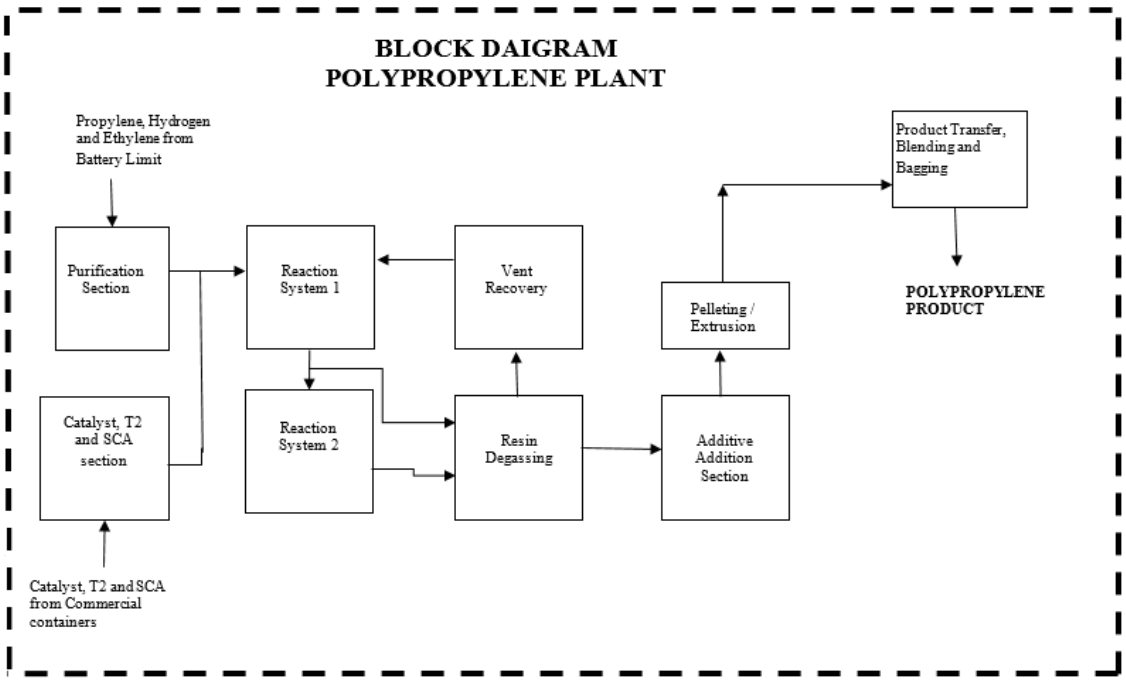

Fig. B.2: Block Flow Diagram of PP Plant

B.3 VOC Emissions Control Unit – Thermal Oxidiser

In Polypropylene plant, during production of "Peroxide grades" of PP, Volatile organic compounds (VOC's) are expected in the gaseous vents from the blending (silos) system. VOC's are released along with air from blenders with air as the major component. These grades are manufactured for few days in a year's operation. Amount of VOC is 270 mg/Nm^3 (normal) and 500 mg/Nm^3 (design).

VOC's generated needs to be treated before releasing them to atmosphere to bring them within permissible limit (150 mg/Nm^3). For achieving this a suitable capacity Thermal oxidiser unit shall be installed.

Air along with VOC's from blending silos is passed through a blower to get the pressure desired pressure. This stream is heated in the Thermal Oxidiser to a very high temperature (typically 820-850ºC) with the help of Fuel gas. In this environment the VOCs are converted to CO_2, water vapour (H2O), and usable heat. Finally, the treated stream containing permissible amount of VOCs is cooled and released to atmosphere.

A typical sketch of the thermal oxidiser is shown below in **Fig. B.3**.

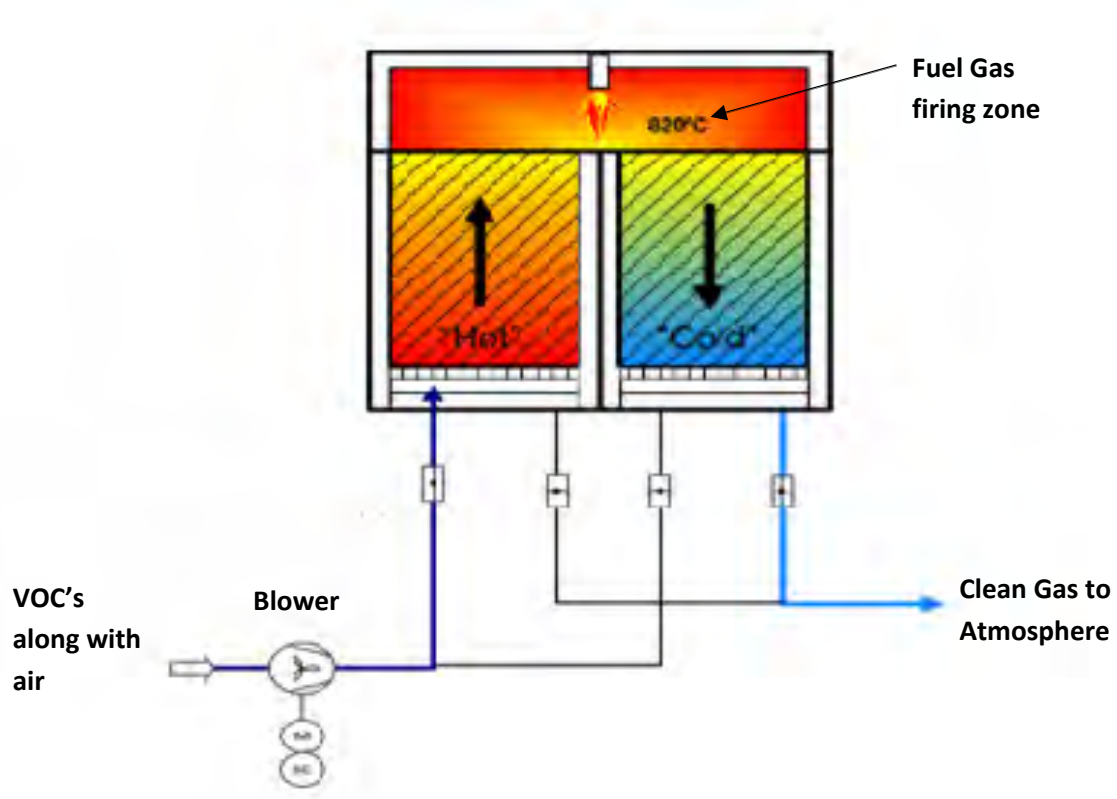

Fig. B.3: Typical Sketch of Thermal Oxidiser for Control of VOC Emissions

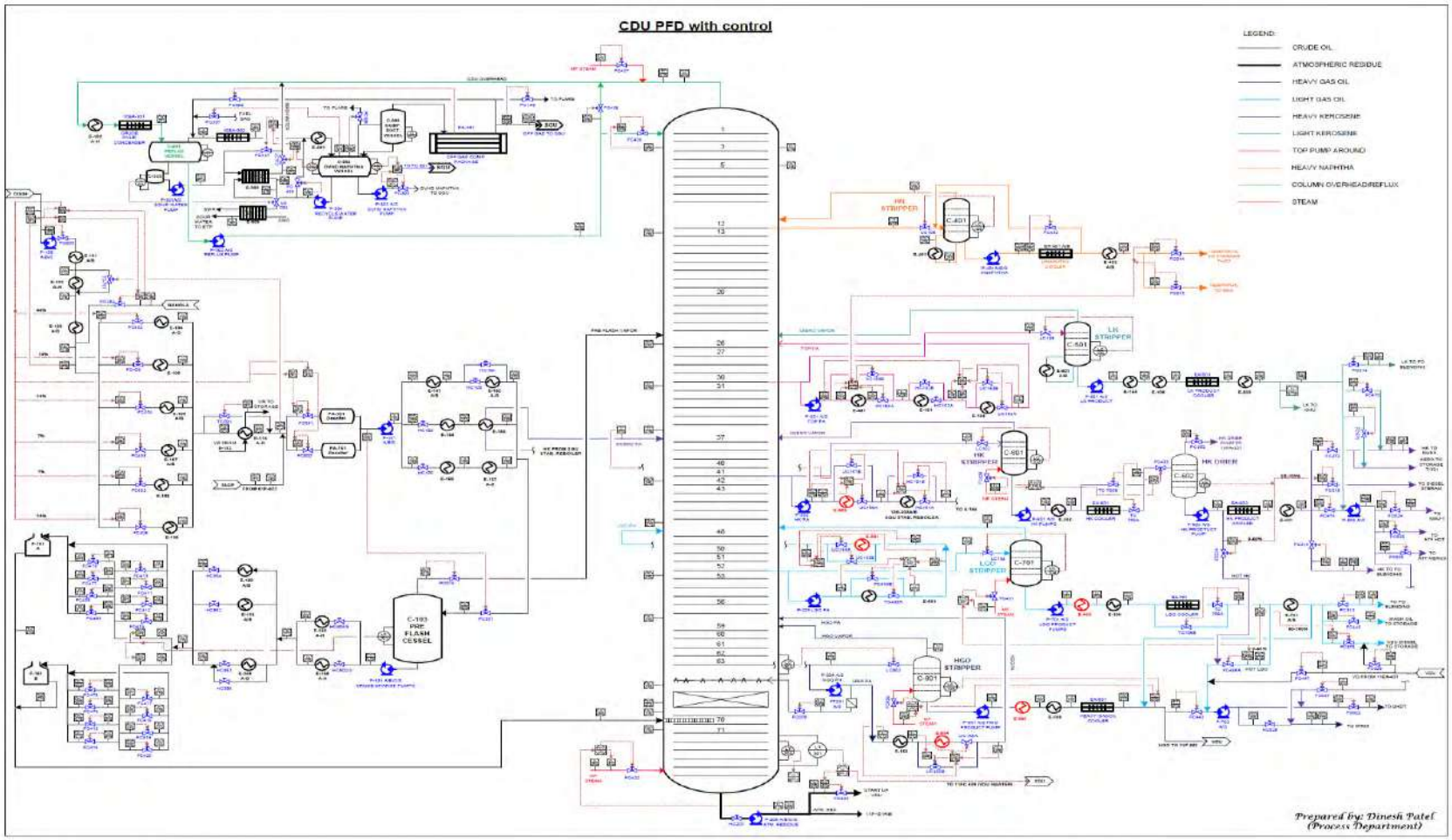

Fig. A.1: Typical Process Flow Diagram for Crude Distillation Unit (CDU) for the Existing Refinery

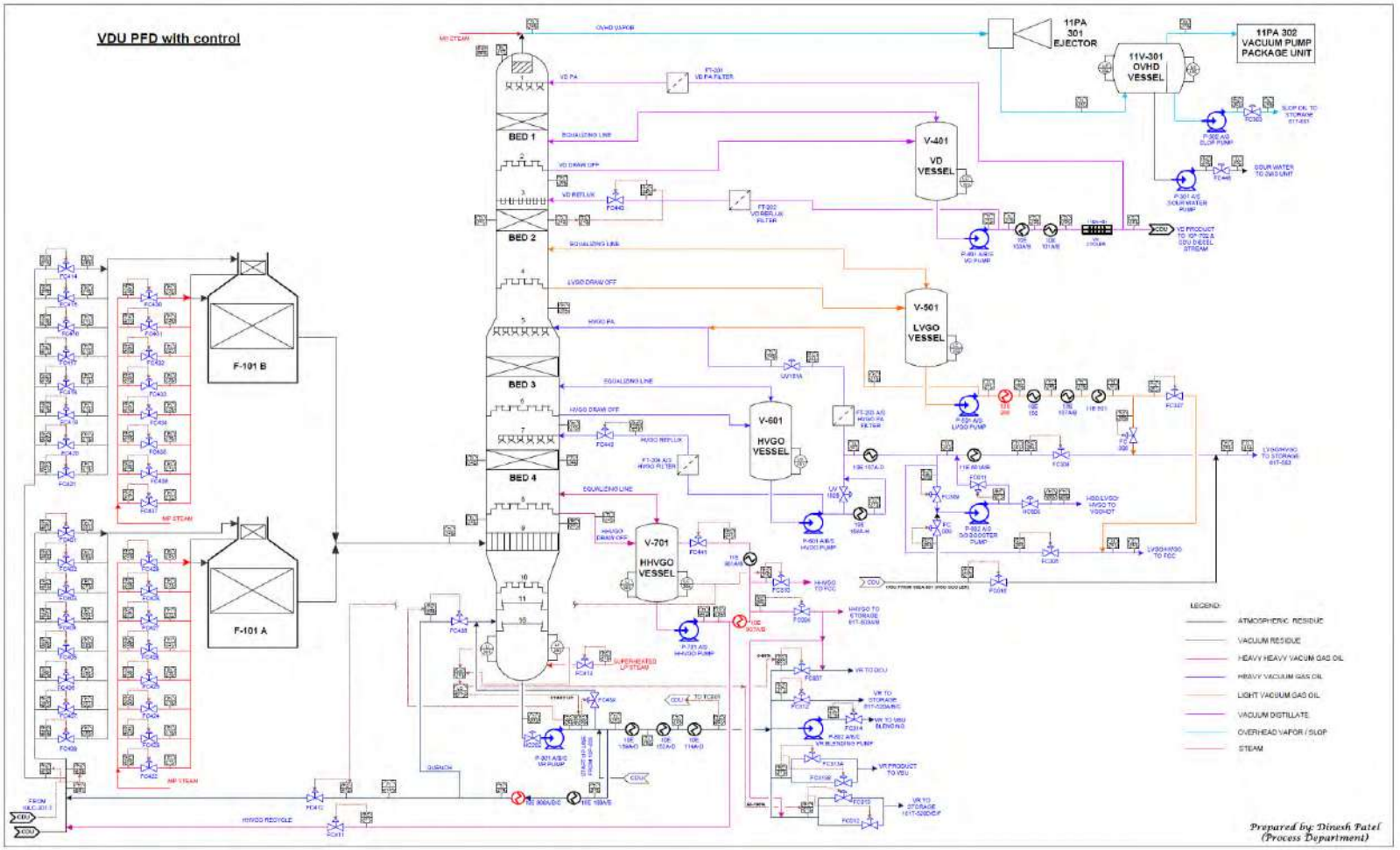

Fig. A.2: Typical Process Diagram of Vacuum Distillation Unit (VDU) for the Existing Refinery

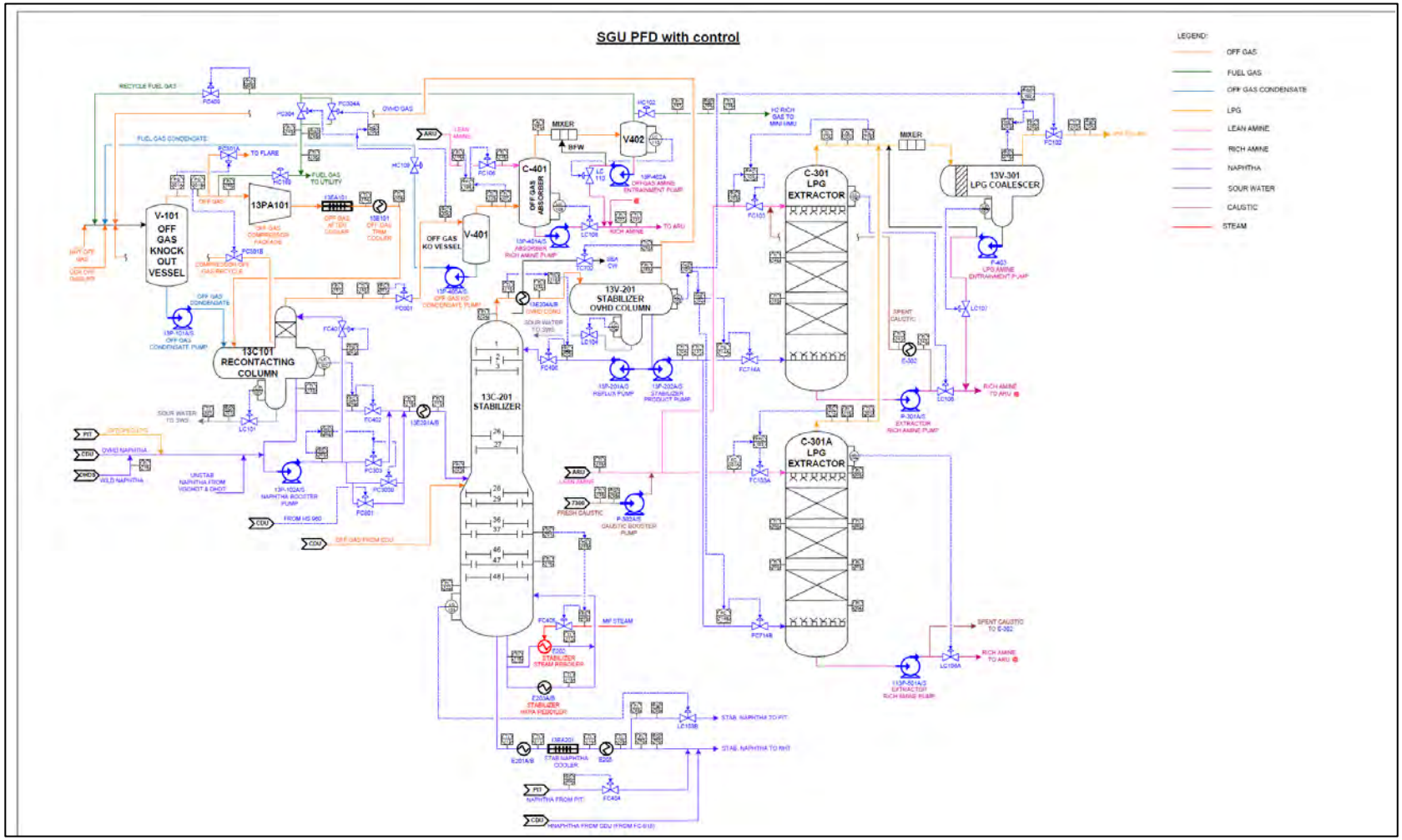

Fig. A.3: Typical Process Diagram of Saturated Gas Separation Unit (SGU) with Control for the Existing Refinery

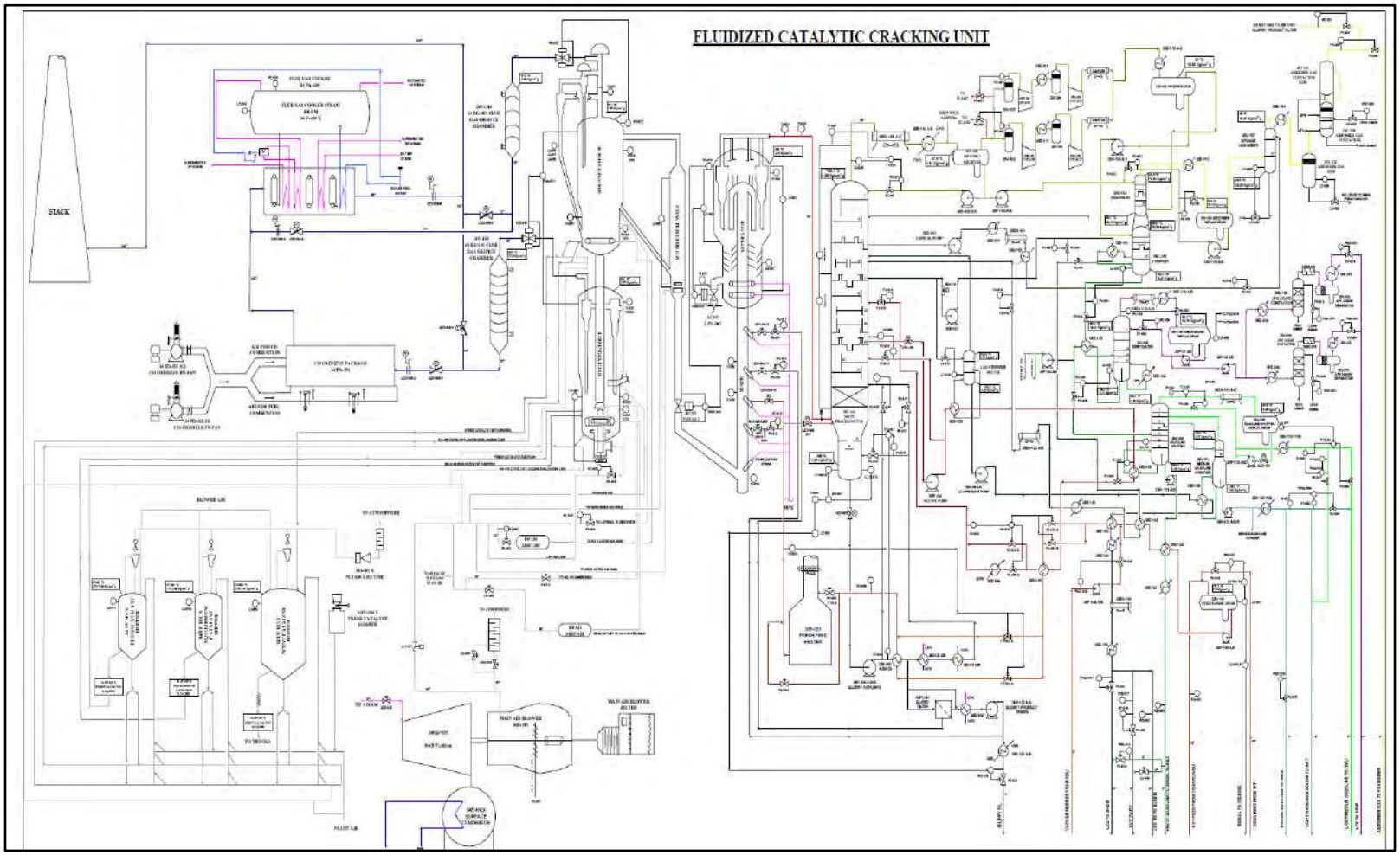

Fig. A.4: Typical Process Diagram for Fluidized Catalytic Cracking Unit (FCCU) for the Existing Refinery

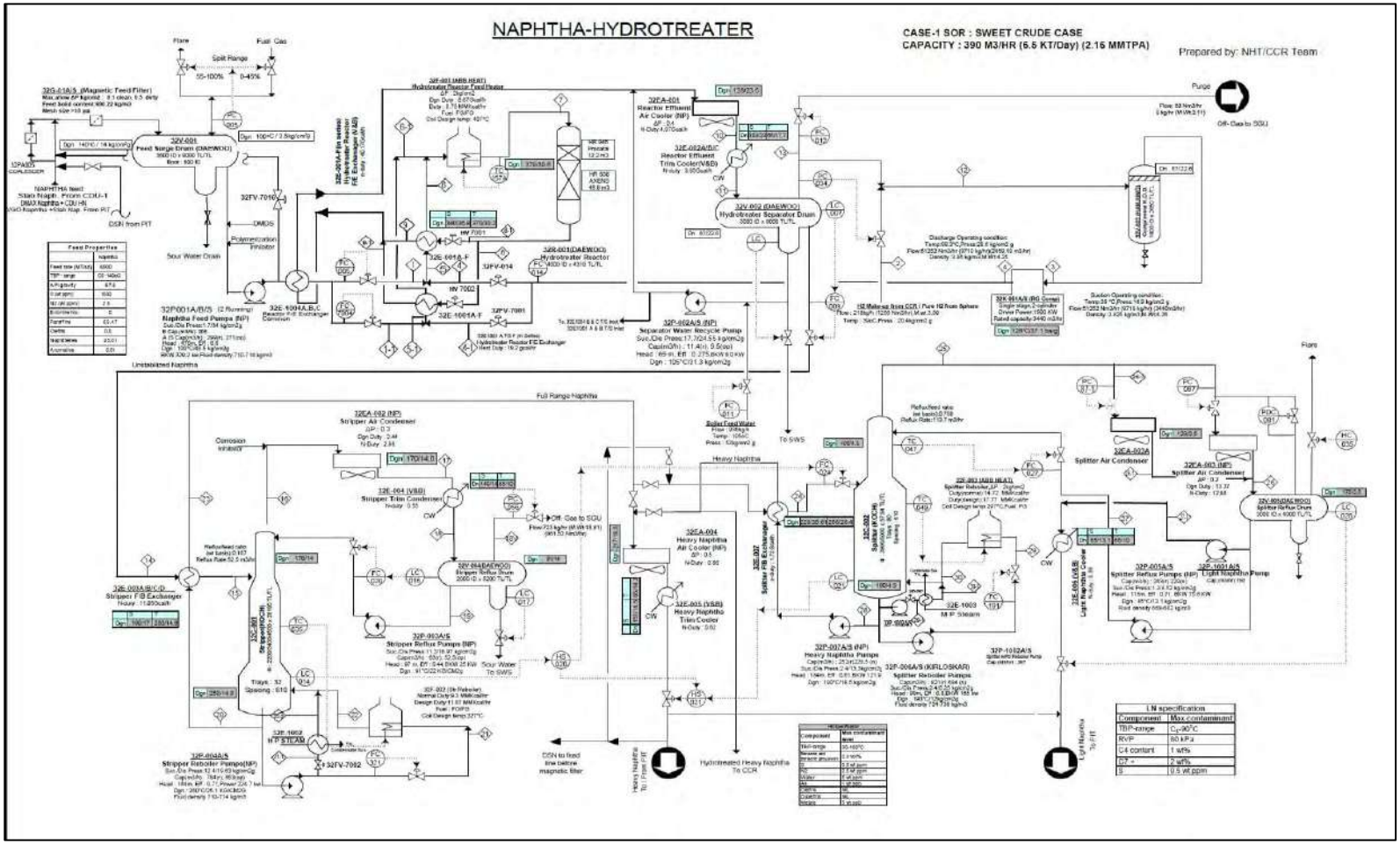

Fig. A.5: Typical Process Diagram for Nephtha-Hydrotreater (NHU) Unit for the Existing Refinery

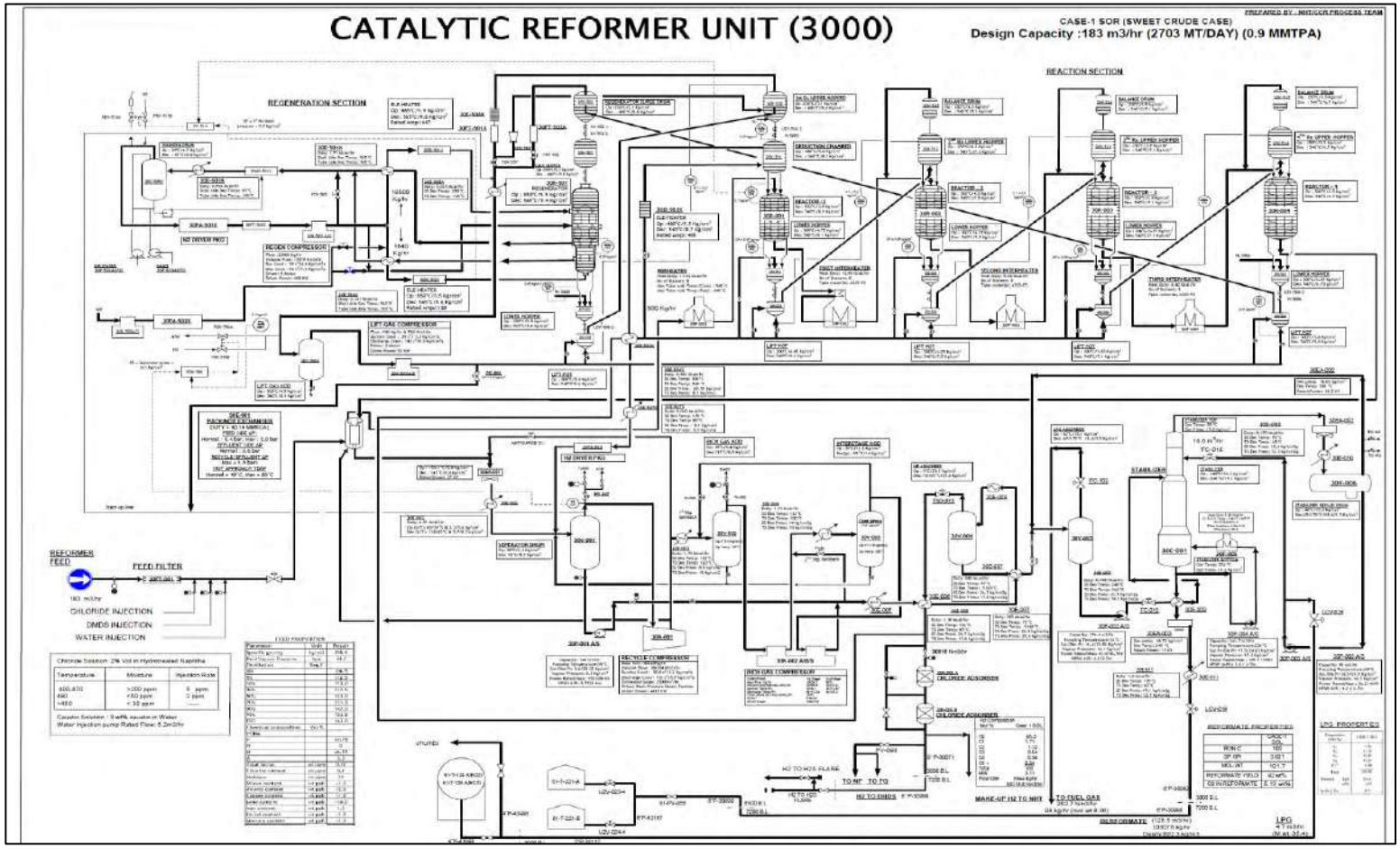

Fig. A.6: Schematic Process Diagram for Catalytic Reformer Unit (CRU) for the Existing Refinery

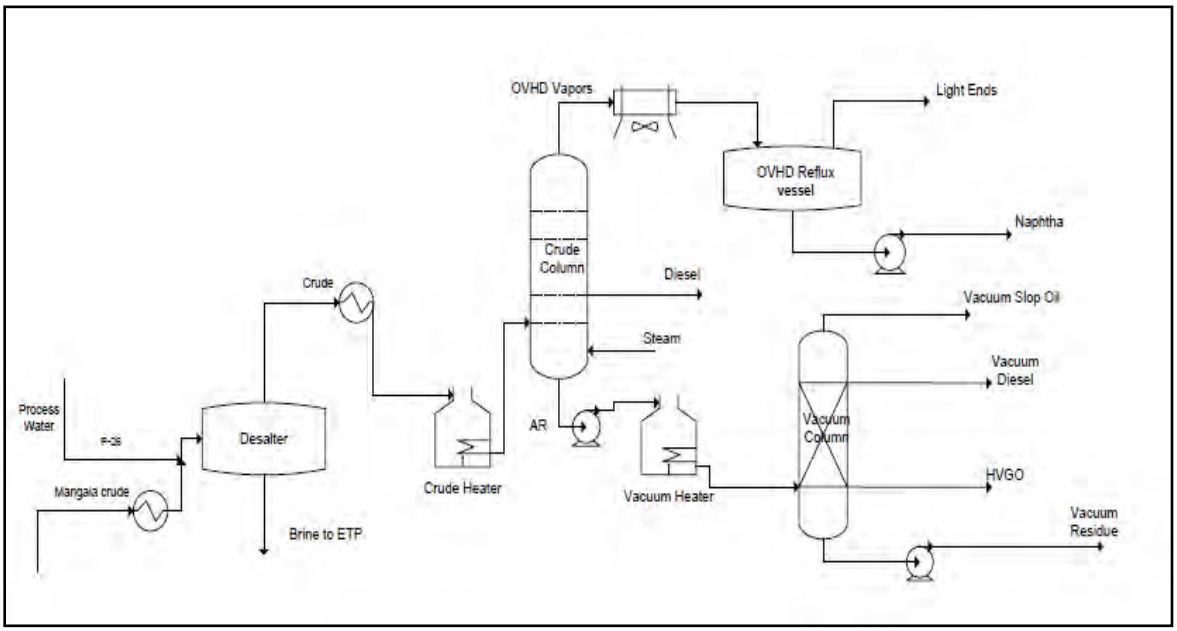

Fig. A.7: Typical Process Diagram for Crude Distillation Unit- II (CDU-II) for the Existing Refinery

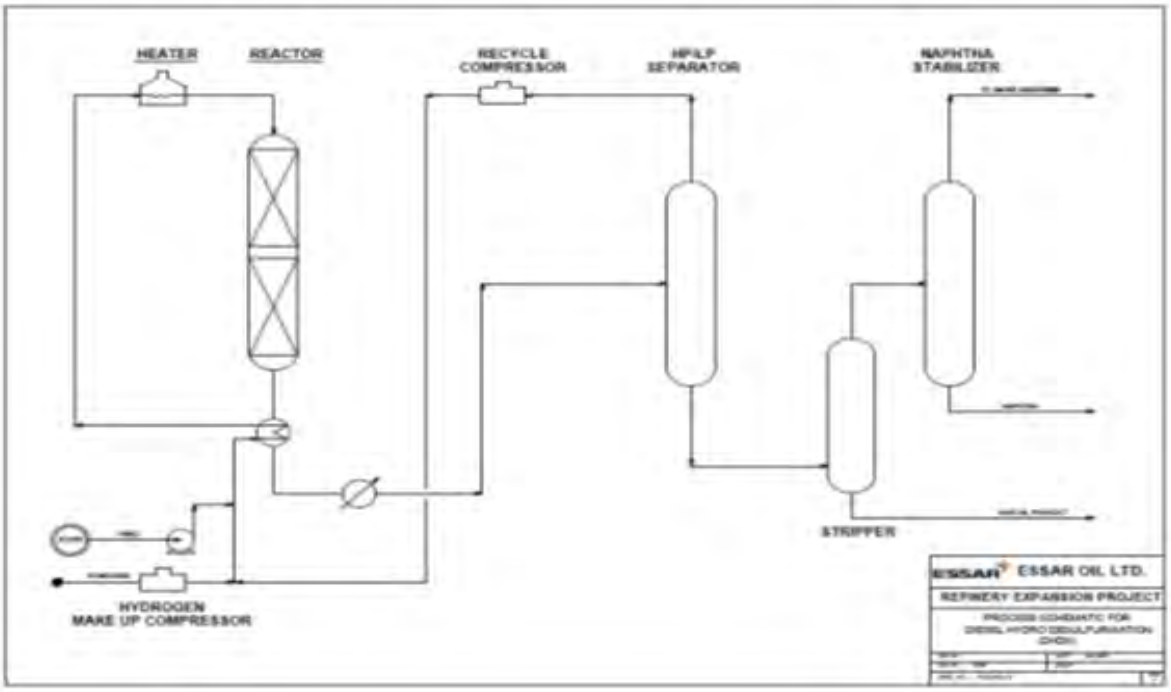

Fig. A.8: Typical Process Diagram for Diesel Hydro Desulfurization (DHDS) for the Existing Refinery

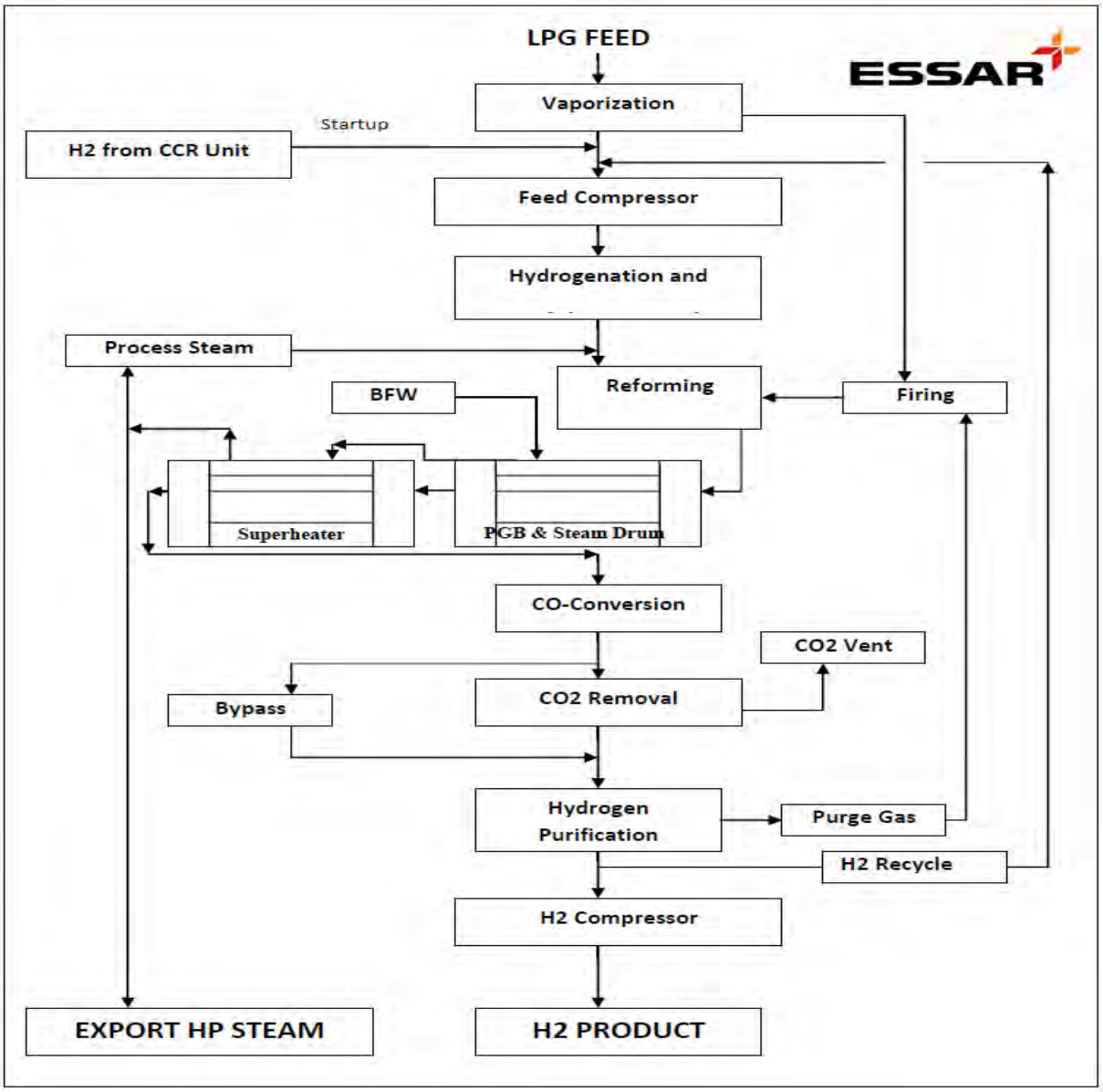

Fig. A.9: Schematic Diagram of Processes include in Mini Hydrogen Unit (MHU) for the Existing Refinery

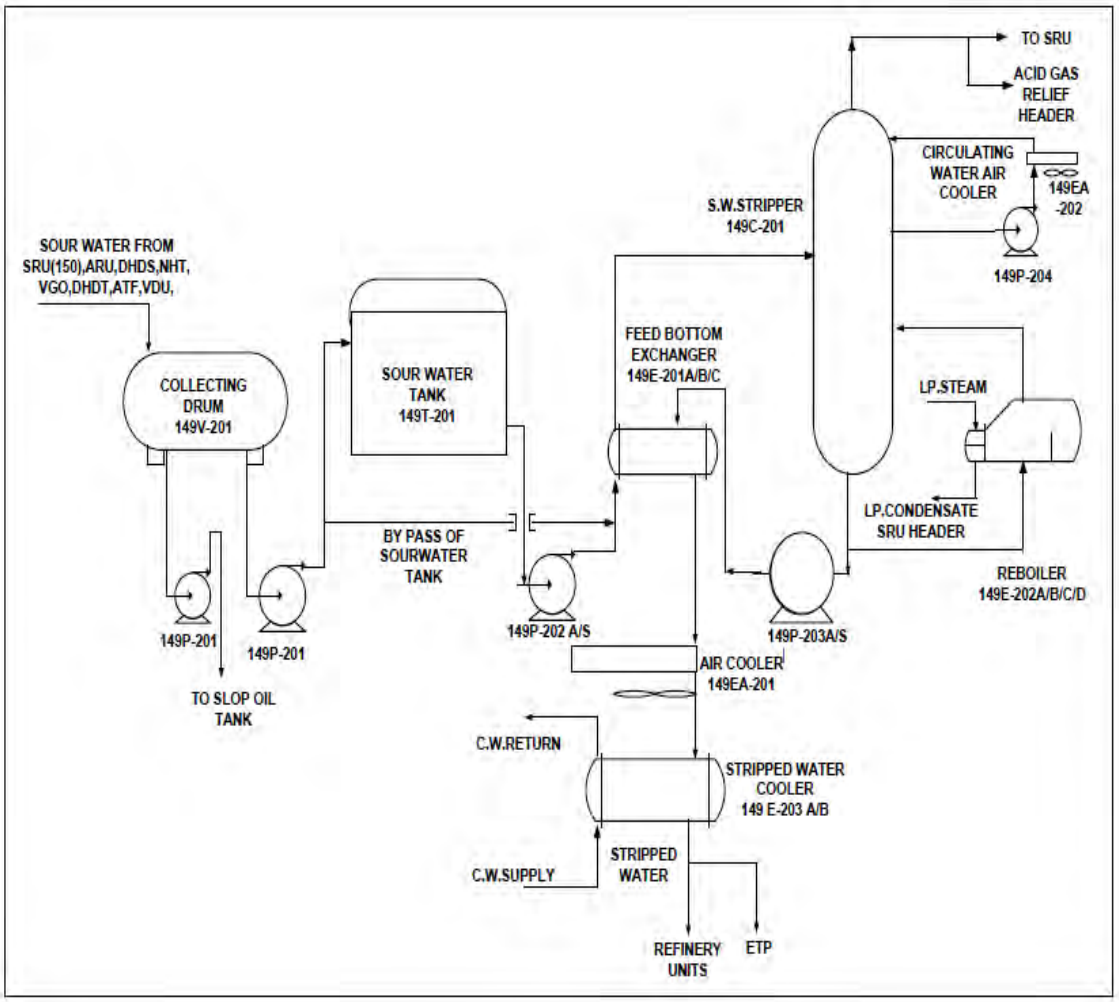

Fig. A.10: Typical Process Diagram for Sour Water Stripper Unit with process Details for the Existing Refinery

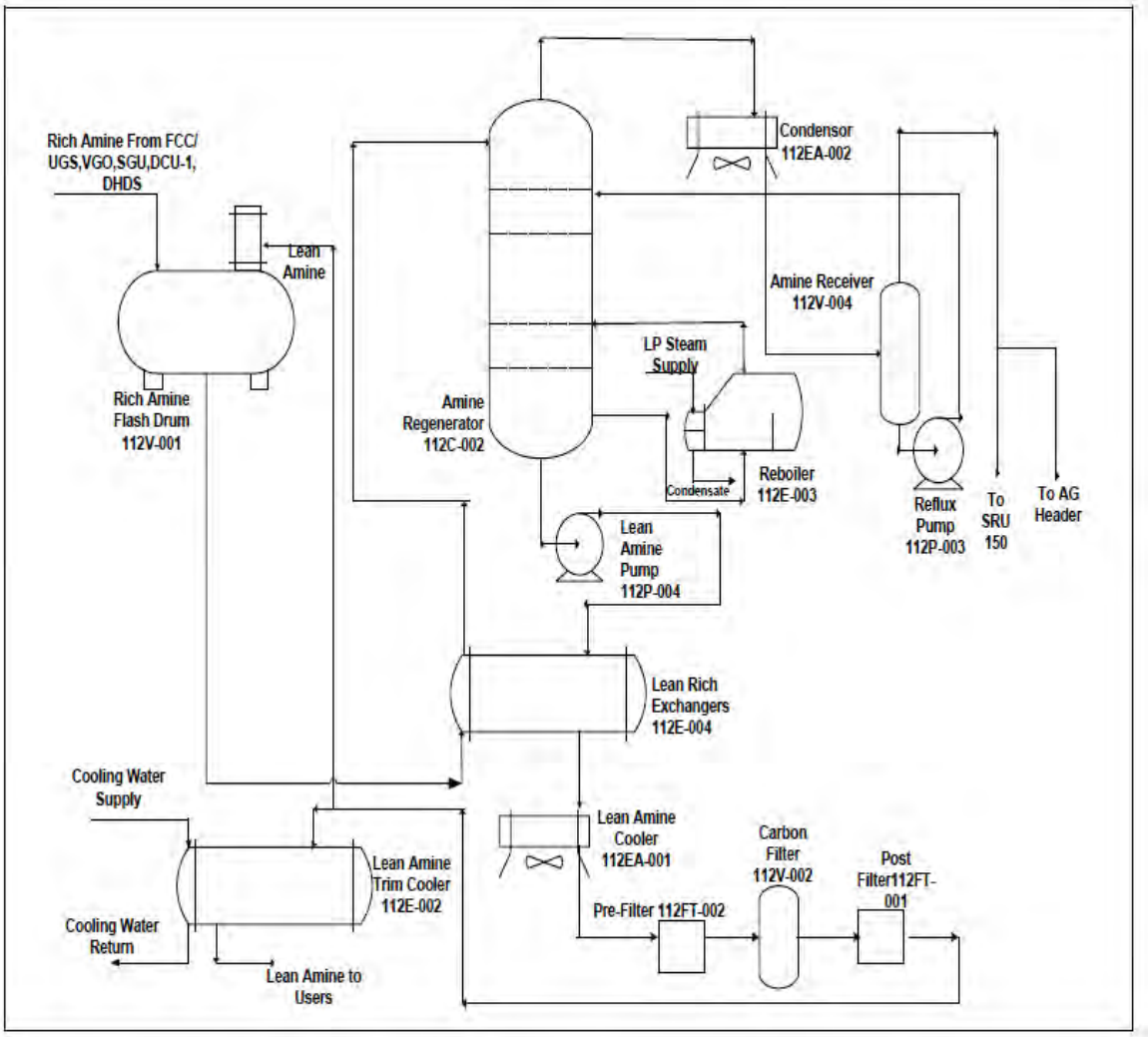

Fig. A.11: Typical Process Diagram of Amine Wash and Regeneration Unit for the Existing Refinery

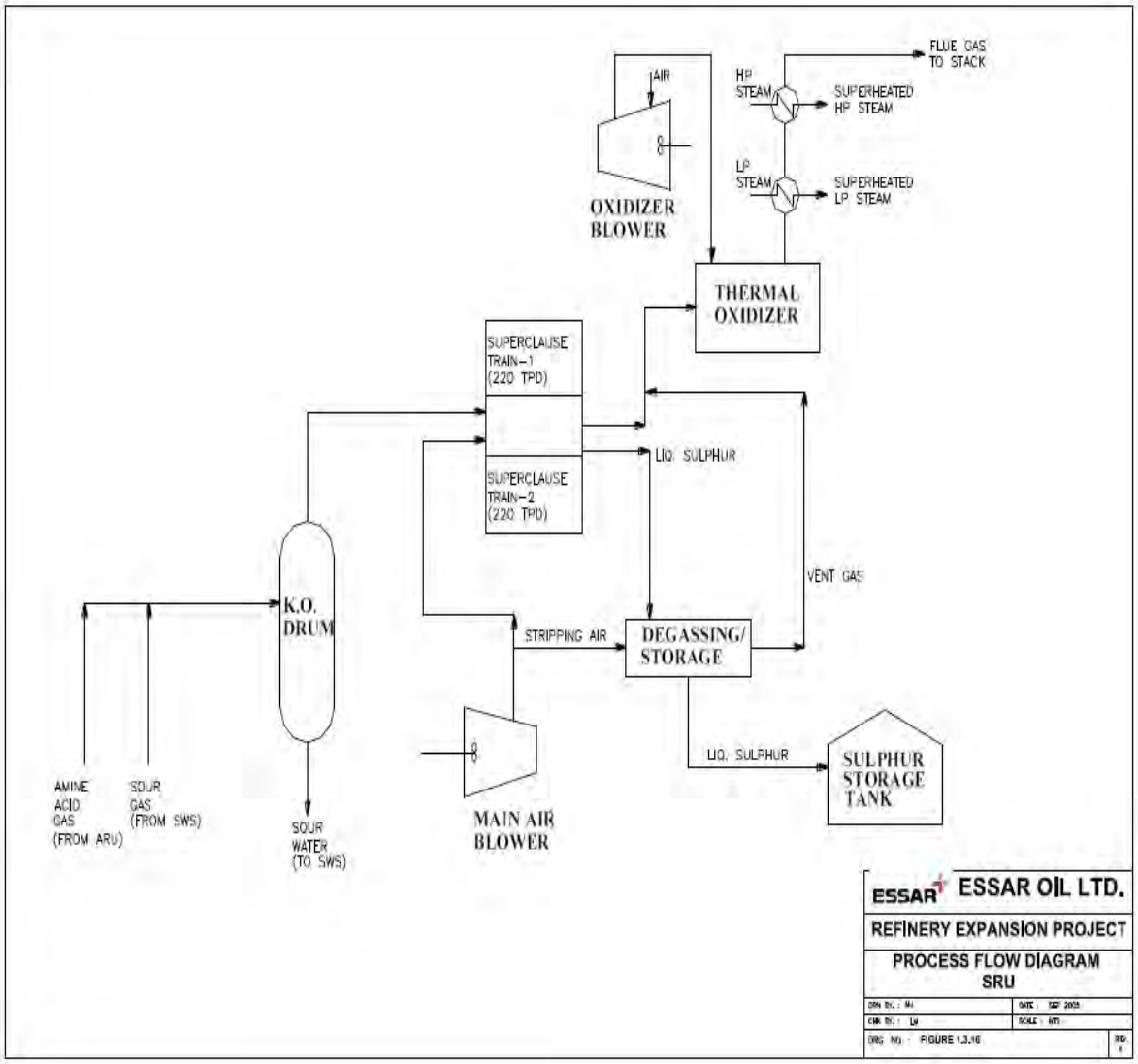

Fig. A.12: Typical Process Diagram to process H_2S from Sour Water Stripper Unit and Amine Regeneration Unit for the Existing Refinery

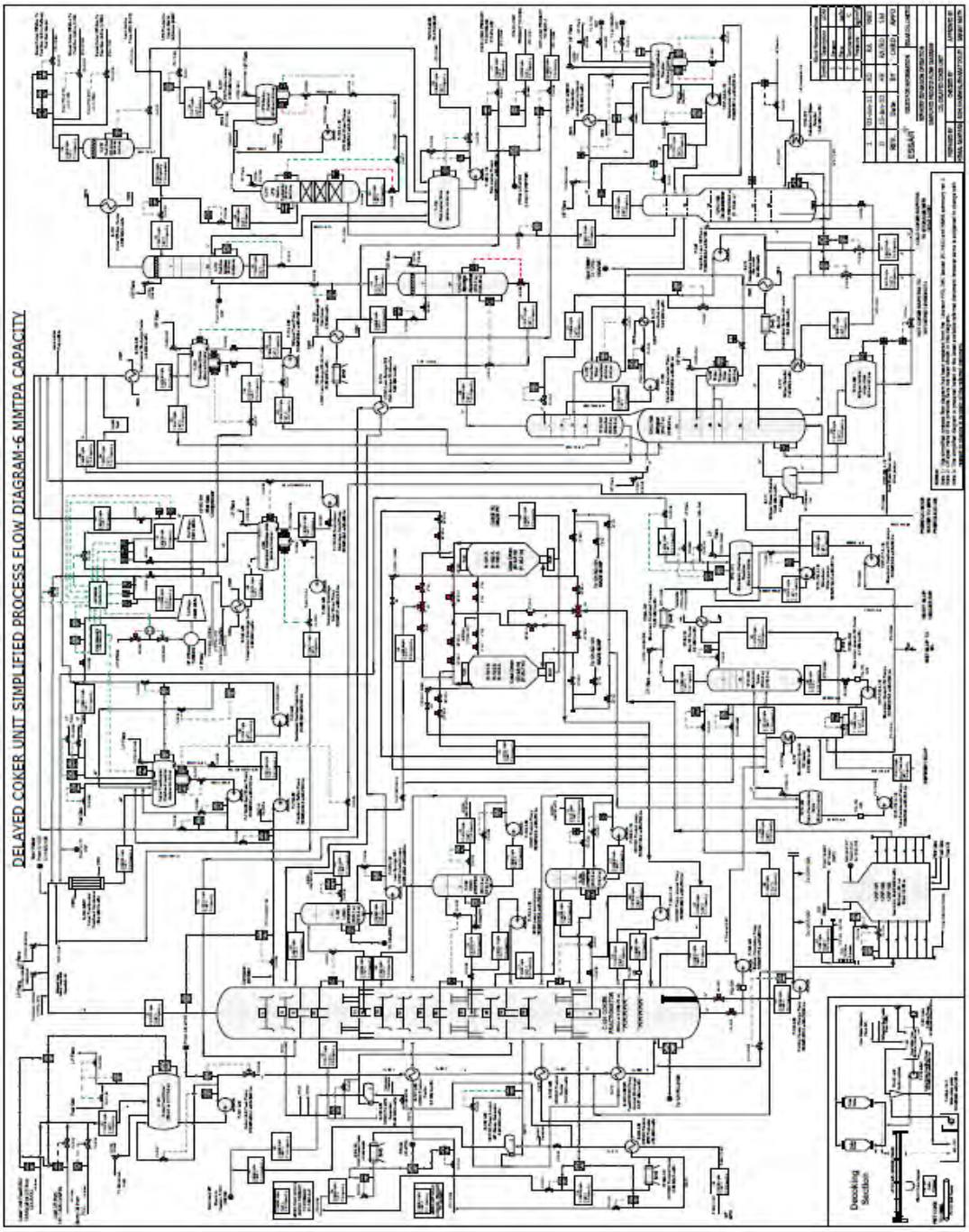

Fig. A.13: Typical Process Diagram for Delayed Coker Unit (DCU) for the Existing Refinery

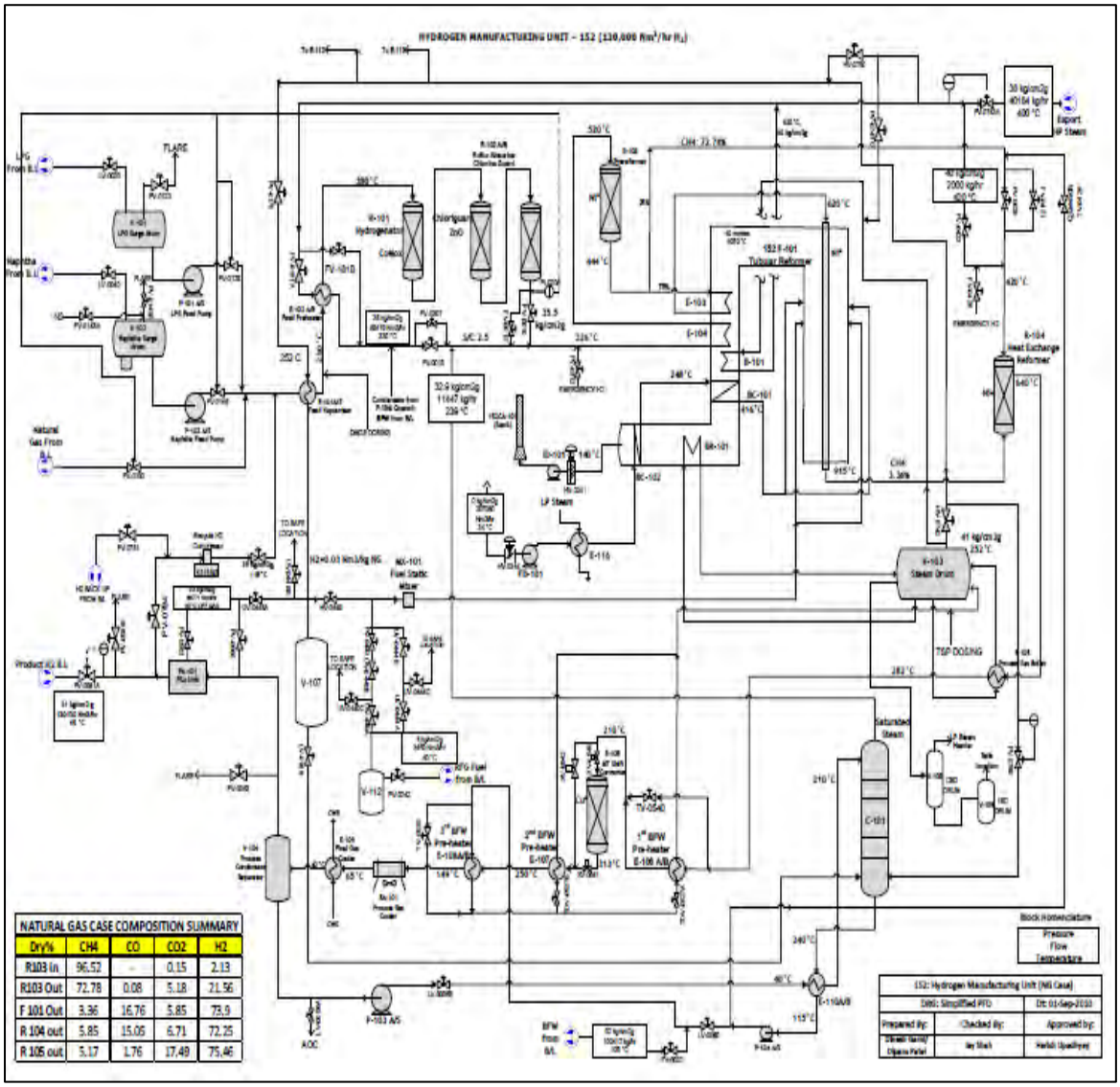

Fig. A.14: Typical Process Diagram for Hydrogen Manufacturing Unit (HMU-I) for the Existing Refinery

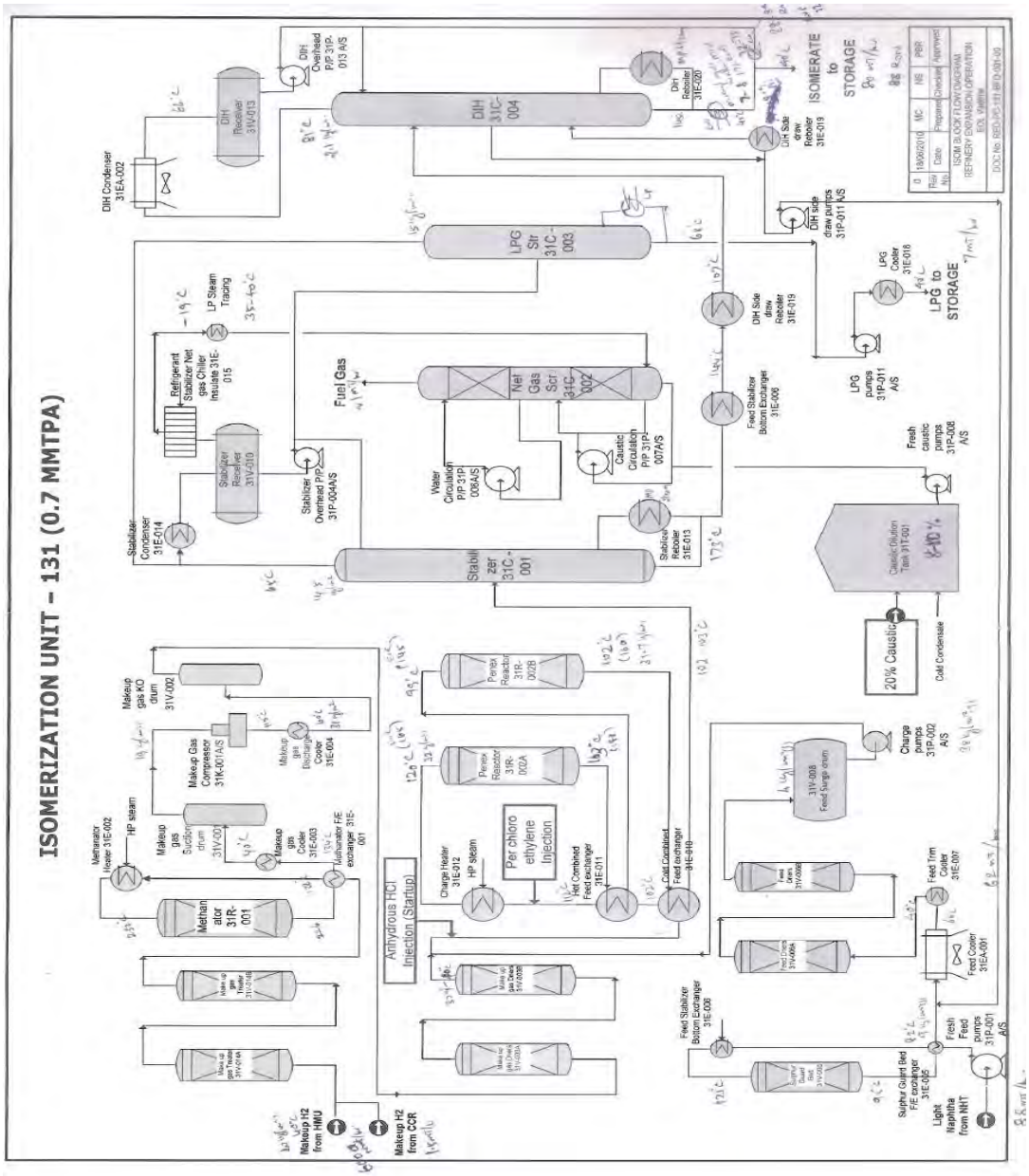

Fig. A.15: Typical Process Diagram for ISOM (Isomerization Unit) for the Existing Refinery

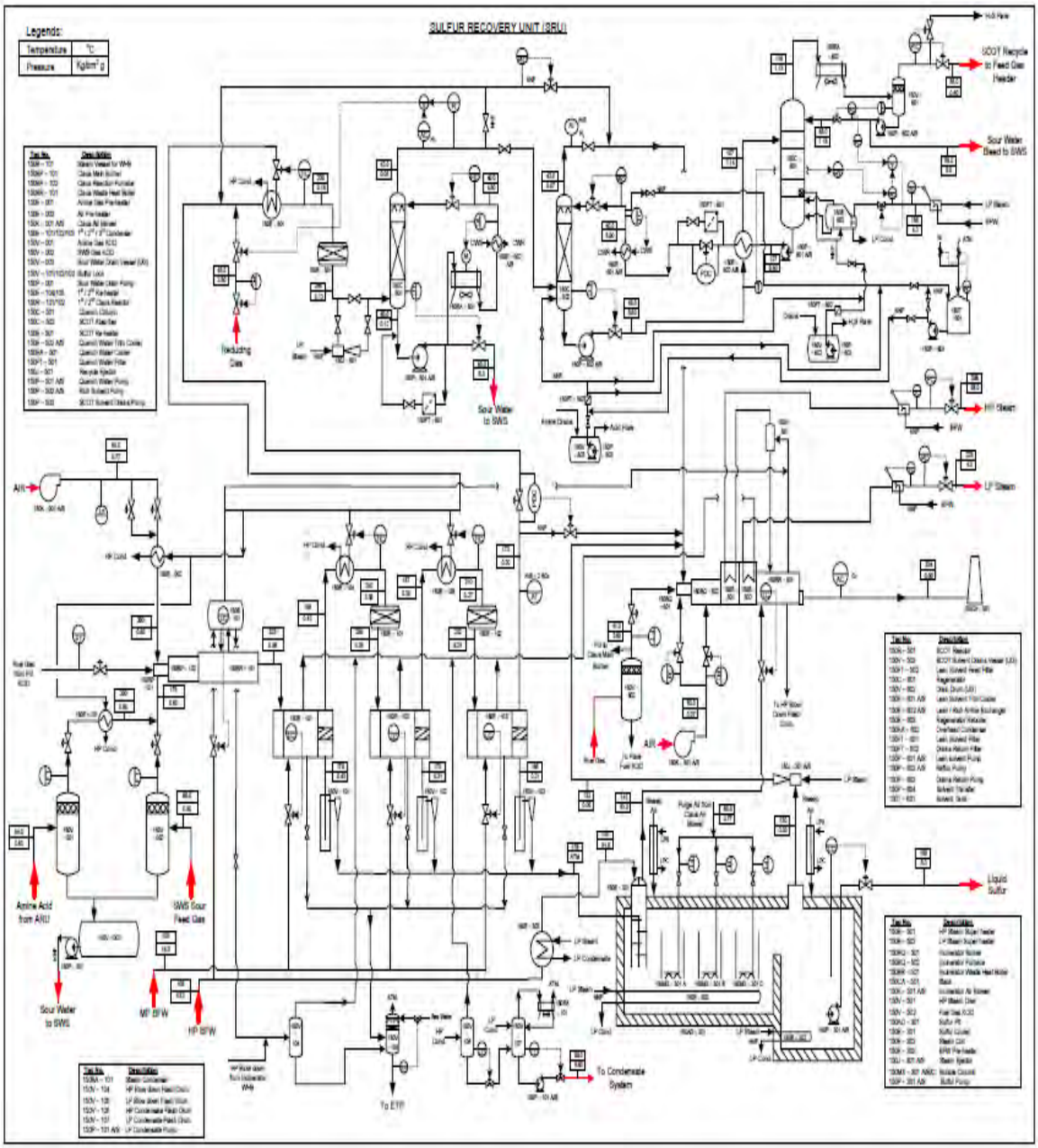

Fig. A.16: Typical Process Diagram for Sulphur Recovery Unit-1 (SRU-1) for the Existing Refinery

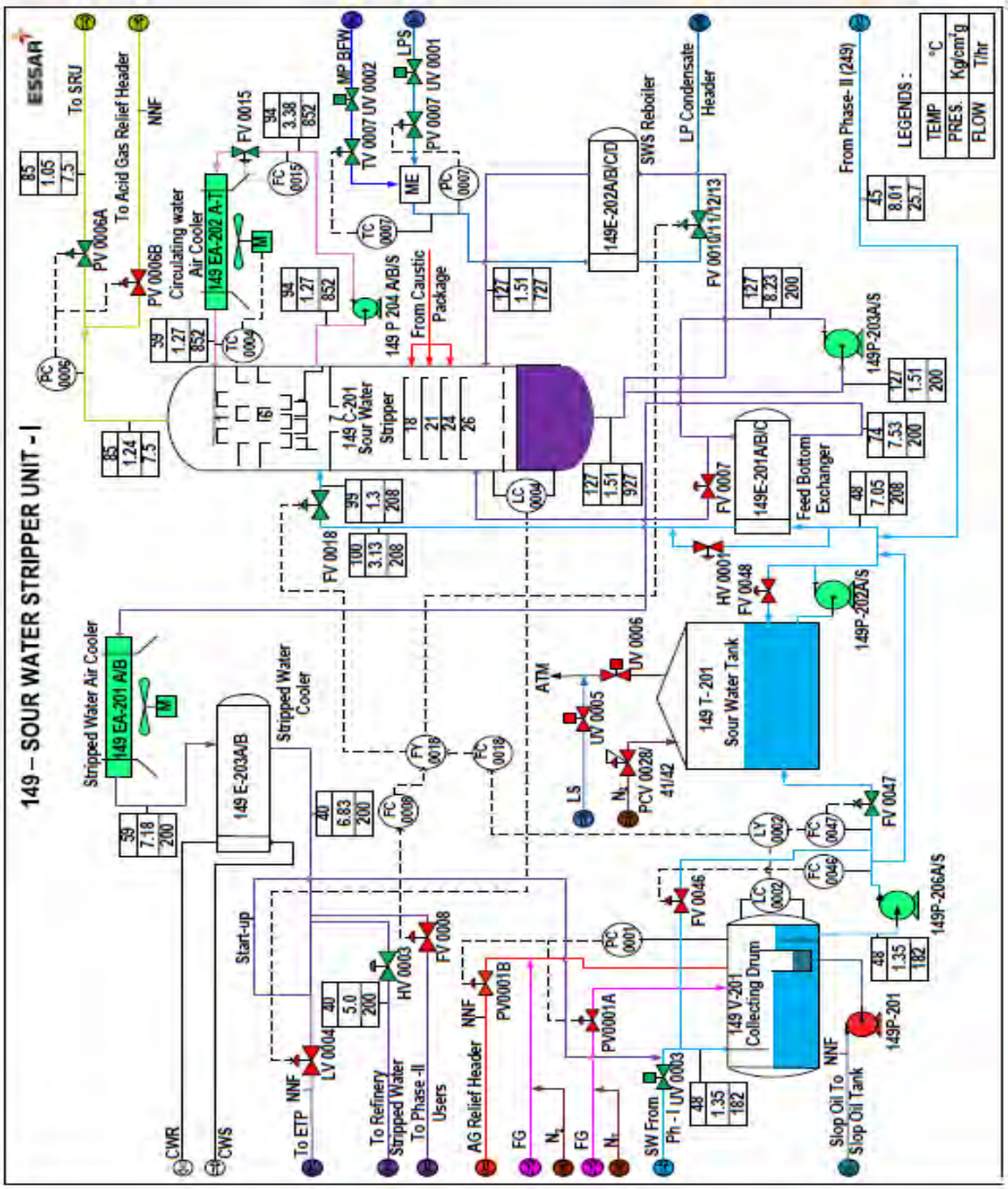

Fig. A.17: The Schematic Process Diagram of Expansion Sour Water Stripper Unit (SWS-I) for the Existing Refinery

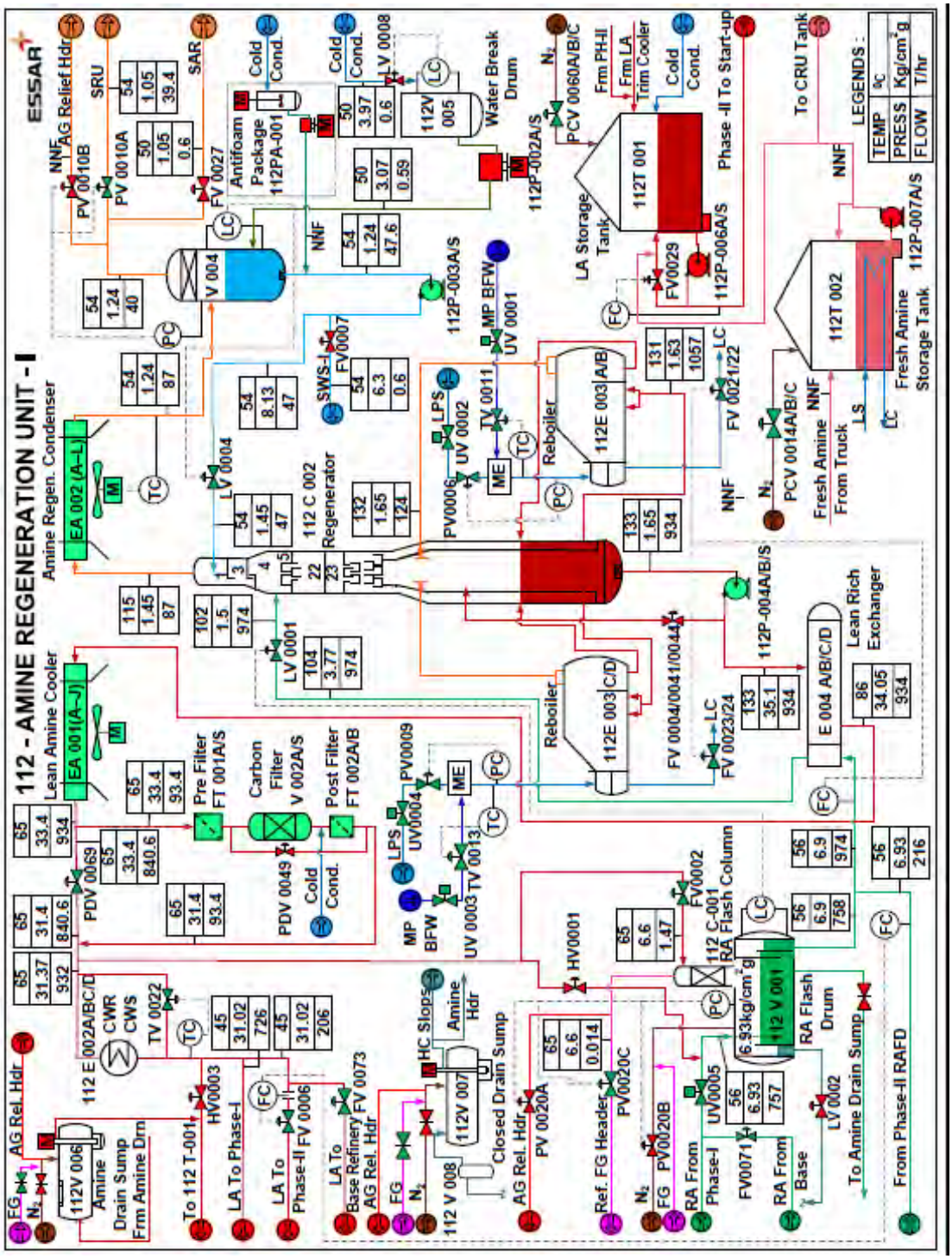

Fig. A.18: Schematic Flow Diagram Of Dehydro Diesel Treater Unit for the Existing Refinery

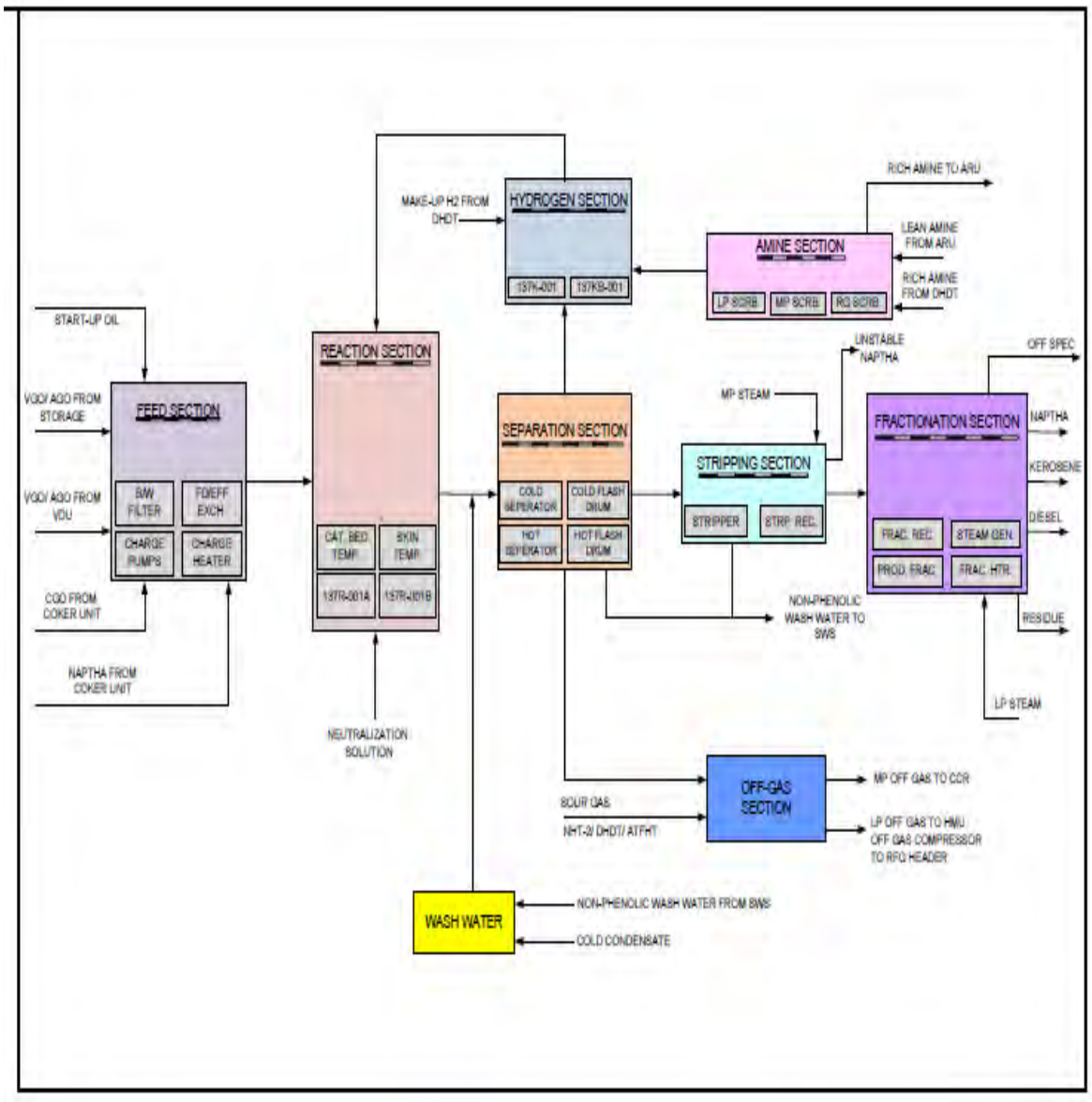

Fig. A.19: Schematic Flow Diagram of VGO Hydrotreater Unit for the Existing Refinery

Annexure 4

Table A4.1: Date wise Air Quality Status at Refinery Complex (AQ1)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	03-04-2018	88	26	18	22
2.	04-04-2018	77	26	14	23
3.	06-04-2018	62	20	20	21
4.	09-04-2018	74	18	21	24
5.	10-04-2018	78	24	21	24
6.	12-04-2018	71	22	26	22
7.	17-04-2018	72	21	24	32
8.	18-04-2018	71	18	22	28
9.	19-04-2018	68	21	18	17
10.	23-04-2018	68	16	16	22
11.	24-04-2018	77	25	18	22
12.	26-04-2018	62	19	19	21
13.	01-05-2018	76	24	19	24
14.	07-05-2018	81	28	24	26
15.	14-05-2018	77	26	21	27
16.	22-05-2018	69	22	19	26
17.	01-06-2018	86	21	19	25
18.	07-06-2018	75	18	22	24
19.	14-06-2018	67	16	18	20
20.	22-06-2018	72	20	21	22
Minimum		62	16	14	17
Maximum		88	28	26	32
Average		**74**	**22**	**20**	**24**
Standard Deviation		6.9	3.4	3.0	3.6

Table A4.2: Date wise Air Quality Status at Refinery Township (AQ2)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	31-03-2018	88	26	21	24
2.	03-04-2018	91	28	18	21
3.	04-04-2018	96	34	24	27
4.	11-04-2018	84	22	21	26
5.	12-04-2018	78	18	17	22
6.	17-04-2018	92	31	24	28
7.	18-04-2018	86	26	18	24
8.	25-04-2018	94	24	21	28
9.	26-04-2018	91	22	23	27
10.	09-05-2018	116	37	21	30
11.	06-06-2018	90	32	17	32
12.	07-06-2018	86	30	20	31
13.	12-06-2018	81	26	16	19
14.	13-06-2018	106	33	14	22
15.	21-06-2018	94	28	19	24
16.	22-06-2018	88	31	24	26
17.	25-06-2018	96	22	11	17
Minimum		78	18	11	17
Maximum		116	37	24	32
Average		**92**	**28**	**19**	**25**
Standard Deviation		9.0	5.1	3.7	4.1

Table A4.3: Date wise Air Quality Status at Vadalia Sinhan (AQ3)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	09-04-2018	88	26	18	21
2.	10-04-2018	86	24	15	19
3.	11-04-2018	84	31	21	24
4.	15-04-2018	76	22	14	18
5.	20-04-2018	91	33	24	27
6.	23-04-2018	82	24	26	31
7.	24-04-2018	87	32	16	19
8.	03-05-2018	65	23	15	23
9.	04-05-2018	80	25	18	21
10.	07-05-2018	95	31	11	20
11.	08-05-2018	90	27	14	21
12.	16-05-2018	85	25	12	20
13.	17-05-2018	70	20	20	24
14.	21-05-2018	76	20	18	25
15.	22-05-2018	62	18	23	27
16.	30-05-2018	98	30	15	20
17.	31-05-2018	73	25	15	23
18.	04-06-2018	84	29	17	20
19.	05-06-2018	80	25	20	24
20.	14-06-2018	94	33	16	19
21.	15-06-2018	88	26	19	21
22.	19-06-2018	91	31	22	26
23.	20-06-2018	86	24	24	31
Minimum		62	18	11	18
Maximum		98	33	26	31
Average		**83**	**26**	**18**	**23**
Standard Deviation		9.3	4.3	4.0	3.7

Table A4.4: Date wise Air Quality Status at Kajurda Patiya (AQ4)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	29-03-2018	98	33	18	22
2.	02-04-2018	91	28	21	26
3.	03-04-2018	86	24	26	28
4.	12-04-2018	84	32	31	36
5.	13-04-2018	88	26	24	28
6.	17-04-2018	112	36	22	27
7.	18-04-2018	82	31	16	26
8.	25-04-2018	94	33	21	31
9.	26-04-2018	114	34	24	33
10.	01-05-2018	130	32	21	30
11.	02-05-2018	98	26	26	32
12.	09-05-2018	95	30	20	31
13.	10-05-2018	107	35	25	27
14.	14-05-2018	115	37	23	30
15.	15-05-2018	96	32	26	28
16.	23-05-2018	102	35	21	32
17.	24-05-2018	86	28	29	30
18.	28-05-2018	93	30	22	34
19.	29-05-2018	105	35	24	32
20.	06-06-2018	140	42	28	30
21.	07-06-2018	93	35	25	33
22.	12-06-2018	112	34	16	19
23.	13-06-2018	96	31	18	22
24.	21-06-2018	88	26	22	26
25.	22-06-2018	84	24	24	28
26.	25-06-2018	106	32	21	26
Minimum		82	24	16	19
Maximum		140	42	31	36
Average		**100**	**32**	**23**	**29**
Standard Deviation		14.3	4.3	3.7	3.9

Table A4.5: Date wise Air Quality Status at Khajurda Village (AQ5)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	30-03-2018	84	26	21	28
2.	04-04-2018	94	31	18	21
3.	09-04-2018	110	38	17	19
4.	10-04-2018	96	28	14	21
5.	19-04-2018	106	36	31	36
6.	20-04-2018	84	24	26	31
7.	24-04-2018	96	27	31	34
8.	03-05-2018	70	18	26	30
9.	04-05-2018	85	27	23	29
10.	07-05-2018	93	30	17	23
11.	08-05-2018	80	23	21	25
12.	16-05-2018	73	21	18	29
13.	17-05-2018	81	25	22	26
14.	21-05-2018	75	20	17	31
15.	22-05-2018	60	18	15	30
16.	30-05-2018	78	25	19	28
17.	31-05-2018	88	29	16	33
18.	04-06-2018	92	34	19	27
19.	05-06-2018	77	25	13	30
20.	14-06-2018	86	24	16	22
21.	15-06-2018	74	21	21	26
22.	19-06-2018	81	32	24	28
23.	20-06-2018	94	28	18	21
Minimum		60	18	13	19
Maximum		110	38	31	36
Average		**85**	**27**	**20**	**27**
Standard Deviation		11.6	5.4	4.9	4.5

Table A4.6: Date wise Air Quality Status at Jhankar Village (AQ6)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	30-03-2018	87	28	21	26
2.	05-04-2018	94	32	18	22
3.	09-04-2018	81	24	24	28
4.	10-04-2018	88	31	22	26
5.	19-04-2018	82	26	17	28
6.	23-04-2018	76	22	22	29
7.	24-04-2018	81	31	18	25
8.	03-05-2018	70	25	17	21
9.	04-05-2018	86	28	15	20
10.	07-05-2018	80	25	19	24
11.	08-05-2018	93	32	16	20
12.	16-05-2018	80	27	12	23
13.	17-05-2018	91	34	15	27
14.	21-05-2018	75	23	11	22
15.	22-05-2018	88	29	13	23
16.	30-05-2018	82	25	10	27
17.	31-05-2018	73	16	16	25
18.	04-06-2018	80	36	12	25
19.	05-06-2018	67	20	14	30
20.	14-06-2018	94	28	18	22
21.	15-06-2018	88	31	21	26
22.	19-06-2018	91	26	24	28
23.	20-06-2018	86	33	17	21
Minimum		67	16	10	20
Maximum		94	36	24	30
Average		**83**	**27**	**17**	**25**
Standard Deviation		7.5	4.8	4.0	3.0

Table A4.7: Date wise Air Quality Status at Padana Village (AQ7)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	30-03-2018	98	33	24	28
2.	03-04-2018	91	28	22	24
3.	04-04-2018	112	34	16	21
4.	12-04-2018	86	26	19	25
5.	13-04-2018	81	31	22	28
6.	17-04-2018	76	22	24	29
7.	18-04-2018	88	33	28	31
8.	24-04-2018	78	24	31	36
9.	25-04-2018	84	21	22	31
10.	01-05-2018	95	33	25	27
11.	02-05-2018	90	30	20	24
12.	09-05-2018	71	25	16	25
13.	10-05-2018	86	29	18	22
14.	14-05-2018	102	34	15	25
15.	15-05-2018	86	27	19	20
16.	24-05-2018	94	35	17	23
17.	25-05-2018	72	22	22	27
18.	28-05-2018	80	26	16	25
19.	29-05-2018	96	34	12	25
20.	06-06-2018	90	25	18	24
21.	07-06-2018	110	36	16	28
22.	13-06-2018	88	26	19	24
23.	21-06-2018	91	33	16	22
24.	22-06-2018	86	27	21	26
25.	25-06-2018	94	22	24	28
Minimum		71	21	12	20
Maximum		112	36	31	36
Average		**89**	**29**	**20**	**26**
Standard Deviation		10.2	4.7	4.4	3.5

Table A4.8: Date wise Air Quality Status at COT Area (AQ8)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	31-03-2018	78	22	18	22
2.	03-04-2018	74	21	21	24
3.	04-04-2018	81	31	16	19
4.	11-04-2018	77	21	22	26
5.	13-04-2018	88	33	24	28
6.	17-04-2018	76	21	28	31
7.	18-04-2018	81	33	22	24
8.	25-04-2018	72	21	18	21
9.	26-04-2018	73	26	21	27
10.	01-05-2018	85	30	18	30
11.	02-05-2018	60	24	23	26
12.	09-05-2018	92	29	25	32
13.	10-05-2018	75	20	17	26
14.	14-05-2018	90	32	21	28
15.	15-05-2018	64	15	16	25
16.	23-05-2018	76	21	18	32
17.	24-05-2018	118	35	15	30
18.	28-05-2018	85	22	17	27
19.	29-05-2018	81	25	19	31
20.	06-06-2018	105	37	22	30
21.	07-06-2018	90	35	17	26
22.	14-06-2018	116	36	22	31
23.	17-06-2018	88	31	15	19
24.	21-06-2018	94	26	19	28
25.	22-06-2018	81	24	22	26
26.	25-06-2018	106	32	16	22
Minimum		60	15	15	19
Maximum		118	37	28	32
Average		**85**	**27**	**20**	**27**
Standard Deviation		14.2	6.1	3.3	3.8

Table A4.9: Date wise Air Quality Status at Mithoi Village (AQ9)

Sr. No.	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1.	29-03-2018	110	38	18	24
2.	05-04-2018	98	31	21	26
3.	06-04-2018	91	28	16	22
4.	09-04-2018	86	26	22	28
5.	10-04-2018	88	31	17	19
6.	19-04-2018	94	28	23	26
7.	20-04-2018	82	26	16	21
8.	03-05-2018	90	27	19	20
9.	04-05-2018	73	21	15	23
10.	07-05-2018	90	29	18	25
11.	08-05-2018	84	25	17	20
12.	16-05-2018	65	18	13	22
13.	17-05-2018	79	23	18	26
14.	21-05-2018	80	29	15	23
15.	22-05-2018	92	34	15	25
16.	30-05-2018	73	28	19	21
17.	31-05-2018	68	20	22	25
18.	04-06-2018	85	26	20	23
19.	05-06-2018	80	23	16	27
20.	14-06-2018	88	31	19	24
21.	15-06-2018	91	26	22	26
22.	19-06-2018	76	22	17	22
23.	20-06-2018	74	21	24	27
Minimum		65	18	13	19
Maximum		110	38	24	28
Average		**84**	**27**	**18**	**24**
Standard Deviation		10.3	4.7	2.9	2.4

ENVIRONMENTAL STANDARDS FOR PETROLEUM OIL REFINERIES

EMISSIONS

- **Standards for emissions from furnaces, boilers and Power Plant**

S. No.	Parameter		Limiting concentration in mg/Nm^3, unless stated	
			Existing refineries	New refineries, furnaces, boilers
1	Sulphur Dioxide (SO_2)	Gas firing	50	50
		Liquid firing	1700	850
2	Oxides of Nitrogen (NO_x)	Gas firing	350	250
		Liquid firing	450	350
3	Particulate Matter (PM)	Gas firing	10	5
		Liquid firing	100	50
4	Carbon Monoxide (CO)	Gas firing	150	100
		Liquid firing	200	150
5	Nickel + Vanadium (Ni + V)	Liquid firing	5	5
6	Hydrogen Sulphide (H_2S) in fuel gas	-	150	150
7	Sulphur content in liquid fuel, weight %	-	1.0	0.5

Notes:

1. In case of mixed fuel (gas and liquid) use, the limit is to be computed based on heat supplied by gas and liquid fuels.

2. All the furnaces/boilers with heat input of 10 million kilo calories/hour or more shall have continuous systems for monitoring of SO_2 and NO_x. Manual monitoring for all the emission parameters in such furnaces/boilers shall be carried out once in two months.

3. All the emission parameters in furnaces/boilers having heat input less than 10 million kilo calories/hour will be monitored once in a quarter.

4. In case of continuous monitoring, one hourly average concentration values shall be met 98% of the time in a month. Any concentration value obtained through manual monitoring, if exceeds the limiting concentration value, shall be considered as non-compliance.

5. Data on Ni and V content in the liquid fuel (in ppm) shall be reported. Ni and V content in the liquid fuel could be monitored once in six months, if liquid fuel source & quality are not changed. In case of changes, measurement is necessary after every change.

➢ **Standards for emissions from FCC regenerators**

S. No.	Parameter	Limiting concentration in mg/Nm³, unless stated		
		Existing refineries		New refineries or FCC
		Hydro-processing of FCC feed	Other than Hydro-processing of FCC feed	
1	Sulphur Dioxide (SO_2)	500	1700	500 (for hydro-processed feed) 850 (for other feed)
2	Oxides of Nitrogen (NO_x)	400	450	350
3	Particulate Matter (PM)	100	100	50
4	Carbon Monoxide (CO)	400	400	300
5	Nickel + Vanadium (Ni + V)	2	5	2
6	Opacity, %	30	30	30

Notes:

1. In case part feed is hydro-processed, the emission values will be calculated proportional to the feed rates of untreated and treated feeds.

2. FCC regenerators shall have continuous systems for monitoring of SO_2 and NO_x. One hourly average concentration values shall be met 98% of the time in a month, in case of continuous monitoring. Manual monitoring for all the emission parameters shall be carried out once in two months.

3. Any concentration value obtained through manual monitoring, if exceeds the limiting concentration value, shall be considered as non-compliance.

4. Data on Sulphur (weight %), Ni (ppm) and V (ppm) content in the feed to FCC shall be reported.

5. Limit of CO emissions shall be met except during annual shut down of CO boiler for statutory maintenance.

➢ **Standards for emissions from Sulphur Recovery Units**

S. No.	Plant capacity (Tonnes/day)	Parameter	Existing refineries	New refineries or SRU
1	Above 20	Sulphur recovery, %	98.7	99.5
		H_2S, mg/Nm^3	15	10
2	5 – 20	Sulphur recovery, %	96	98
3	1 – 5	Sulphur recovery, %	94	96
4	All Capacity	Oxides of Nitrogen (NO_x)	350	250
5	All Capacity	Carbon Monoxide (CO)	150	100

Notes:

1. Sulphur recovery units having capacity above 20 TPD shall have continuous systems for monitoring of SO_2. Manual monitoring for all the emission parameters shall be carried out once in a month.

2. Data on sulphur dioxide emissions (mg/Nm^3) shall be reported.

3. Sulphur recovery efficiency shall be calculated on monthly basis, using quantity of sulphur in the feed to SRU and quantity of sulphur recovered.

Fugitive Emissions

- **Standards for emissions from storage of volatile liquids**

General petroleum products

Requirements on type of storage tanks shall be as follow:

S. No.	Total Vapour Pressure (TVP), kPa	Tank Capacity, m^3	Type of Storage Tank
1	> 10	4 – 75	Fixed Roof Tank (FRT) with pressure valve vent
2	10 – 76	75 – 500	Internal Floating Roof Tank (IFRT) or External Floating Roof Tank (EFRT) or Fixed Roof Tank with vapour control or vapour balancing system
3	10 – 76	> 500	Internal Floating Roof Tank or External Floating Roof Tank or Fixed Roof Tank with vapour control system
4	> 76	> 75	Fixed Roof Tank with vapour control system

Notes:

1. Requirement for seals in Floating Roof Tanks:

   (i) IFRT & EFRT are to be provided with double seals with minimum vapor recovery of 96%.

   (ii) Primary seal will be liquid or shoe mounted for EFRT and vapour mounted for IFRT. Maximum seal gap width will be 4 cm and maximum gap area will be 200 cm^2/m of tank diameter.

   (iii) Secondary seal will be rim mounted. Maximum seal gap width will be 1.3 cm and maximum gap area will be 20 cm^2/m of tank diameter.

   (iv) Material of seal and construction should ensure high performance and durability.

2. Fixed Roof Tanks will have vapour control efficiency of 95% and vapour balancing efficiency of 90%.

3. Inspection and maintenance of storage tanks should be carried out under strict control. For the inspection, API RP 575 may be adopted. In-service inspection with regard seal gap should be carried out once in every six months and repair to be implemented in short time. In future, possibility of on-stream repair of both seals will be examined.

Storage of benzene

For storage of benzene, following shall be followed:

1. FRT with vapour to incineration with 99.9% of removal efficiency for volatile organic compounds (VOC).

2. IFRT/EFRT with double seals, emission-reducing roof fitting and fitted with fixed roof with vapor removal efficiency of at least 99%.

Storage of solvents for lube-base oil production (Furfural, NMP, MEK, Toluene and MIBK)

IFRT with double seals and inert gas blanketing with vapour removal efficiency of at least 97%.

Standards for emissions from loading of volatile products

S. No.	Item	Standards
1	Applicable products	Gasoline, Naphtha, Benzene, Toluene, Xylene
2	Type of loading: (i) Road tank truck (ii) Rail tank wagon	 (i) Bottom loading (ii) Top submerged
3	Vapour collection: Road tank truck/ Rail tank wagon	Annual leak testing
Emission control for Road tank truck/ Rail tank wagon loading		
4	Gasoline and Naphtha: (i) VOC reduction, % (ii) Emission, gm/m^3	 (i) 99.5 or (ii) 5
6	Benzene: (i) VOC reduction, % (ii) Emission, mg/m^3	 (i) 99.99 or (ii) 20
7	Toluene/Xylene: (i) VOC reduction, % (ii) Emission, mg/m^3	 (i) 99.98 or (ii) 150

Standards Equipment Leaks

1. **Approach**: Approach for controlling fugitive emissions from equipment leaks shall have proper selection, installation and maintenance of non-leaking or leak-tight equipment. Following initial testing after commissioning, the monitoring for leak detection is to be carried out as a permanent on-going Leak Detection and Repair (LDAR) programme. Finally detected leaks are to be repaired within an allowable time frame.

2. **Components to be covered:** Components that shall be covered under LDAR programme include (i) Block valves; (ii) Control valves; (iii) Pump seals; (iv) Compressor seals; (v) Pressure relief valves; (vi) Flanges – Heat Exchangers; (vii) Flanges – Piping; (viii) Connectors – Piping; (ix) Open ended lines; and (x) Sampling connections. Equipment and line sizes more than 1.875 cm or ¾ in are to be covered.

3. **Applicability:** LDAR programme would be applicable to components (given at 2 above) for following products/compounds: (i) hydrocarbon gases; (ii) Light liquid with vapour pressure @ 20^0C > 1.0 kPa; and (iii) Heavy liquid with vapour pressure @ 20^0C between 0.3 to 1.0 kPa.

4. While LDAR will not be applicable for heavy liquids with vapour pressure < 0.3 kPa, it will be desirable to check for liquid dripping as indication of leak.

5. **Leak definition:** A leak is defined as the detection of VOC concentration more than the values (in ppm) specified below at the emission source using a hydrocarbon analyzer according to measurement protocol (US EPA – 453/R-95-017, 1995 Protocol for equipment leak emission estimates may be referred):

S. No.	Component	General Hydrocarbon		Benzene	
		Till 31st Dec. 2008	w.e.f. January 01, 2009	Till 31st Dec. 2008	w.e.f. January 01, 2009
1	Pump/Compressor	10000	5000	3000	2000
2	Valves/Flanges	10000	3000	2000	1000
3	Other components	10000	3000	2000	1000

6. In addition, any component observed to be leaking by sight, sound or smell, regardless of concentration (liquid dripping, visible vapor leak) or presence of bubbles using soap solution should be considered as leak.

7. **Monitoring requirements and repair schedule:** Following frequency of monitoring of leaks and schedule for repair of leaks shall be followed:

Component	Frequency of monitoring	Repair schedule
Valves/Flanges	Quarterly (semiannual after two consecutive periods with < 2% leaks and annual after 5 periods with < 2% leaks)	Repair will be started within 5 working days and shall be completed within 15 working days after detection of leak for general hydrocarbons. In case of benzene, the leak shall be attended immediately for repair.
Pump seals	Quarterly	
Compressor seals	Quarterly	
Pressure relief devices	Quarterly	
Pressure relief devices (after venting)	Within 24 hours	
Heat Exchangers	Quarterly	
Process drains	Annually	
Components that are difficult to monitor	Annually	
Pump seals with visible liquid dripping	Immediately	Immediately
Any component with visible leaks	Immediately	Immediately
Any component after repair/replacement	Within five days	-

8. The % leaking components should not be more than 2% for any group of components, monitored excluding pumps/compressors. In case of pumps/compressors, it should be less than 10% of the total number of pumps/compressors or three pumps and compressors, whichever is greater.

9. **Emission inventory:** Refinery shall prepare an inventory of equipment components in the plant. After the instrumental measurement of leaks, emission from the components will be calculated using stratified emission factors (USEPA) or any other superior factors. The total fugitive emission will be established.

10. **Monitoring:** Following types of monitoring methods may be judiciously employed for detection of leaks: (i) Instrumental method of measurement of leaks; (ii) Audio, visual and olfactory (AVO) leak detection; and (iii) Soap bubble method.

11. Data on time of measurement & concentration value for leak detection; time of repair of leak; and time of measurement & concentration value after repair of leak should be documented for all the components.

12. Pressure relief and blow down systems should discharge to a vapor collection and recovery system or to flare.

13. Open-ended lines should be closed by a blind flange or plugged.

14. Totally closed-loop should be used in all routine samples.

15. Low emission packing should be used for valves.

16. High integrity sealing materials should be used for flanges.

Standards for VOC emissions from wastewater collection and treatment

1. All contaminated and odorous wastewater streams should be handled in closed systems from the source to the primary treatment stages (oil-water separator and equalization tanks).

2. The collection system should be covered with water seals (traps) on sewers and drains and gas tight covers on junction boxes.

3. Oil-water separators and equalization tanks should be provided with floating/fixed covers. The off-gas generated should be treated to remove at least 90% of VOC and eliminate odor. The system design should ensure safety (prevention of formation of explosive mixture, possible detonation and reduce the impact) by dilution with air/inert gas, installing LEL detector including control devices, seal drums, detonation arrestors, etc. The system should be designed and operated for safe maintenance of the collection and primary treatment systems.

4. Wastewater from aromatics plants (benzene and xylene plants) should be treated to remove benzene & total aromatics to a level of 10 & 20 ppm respectively before discharge to effluent treatment system without dilution.

Source: EPA Notification
[G.S.R 186(E), dt. 18th March, 2008]

Guidelines (Downloadable)
Original Notification (Downloadable)

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

सत्यमेव जयते

भारत का राजपत्र
The Gazette of India

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पर्यावरण और वन मंत्रालय

अधिसूचना

नई दिल्ली, 9 नवम्बर, 2012

सा.का.नि. 820(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6 और 25 के अधीन प्रदत्त शक्तियों का प्रयोग करते हुए, पर्यावरण (संरक्षण) नियम, 1986 का और संशोधन करने के लिए निम्नलिखित नियम बनाती है, अर्थात् :—

1. (1) इन नियमों का संक्षिप्त नाम पर्यावरण (संरक्षण) (चौथा संशोधन) नियम, 2012 है ।

(2) ये राजपत्र में प्रकाशन की तारीख से प्रवृत्त होंगे ।

2. पर्यावरण (संरक्षण) नियम, 1986 में :—

(क) अनुसूची I में क्रम संख्या 38, पैट्रोकेमिकल (आधारभूत और माध्यमिक) और बहिस्राव मानकों से संबंधित प्रविष्टियों के स्थान पर,—

(i) स्तम्भ 2 के अधीन प्रविष्टियों में, "बहिस्राव" शब्द के स्थान पर निम्न अक्षर और शब्द "अ. बहिस्राव" रखे जाएंगे ।

(ii) अंत में, निम्न प्रविष्टियां रखी जाएंगी, अर्थात् :—

क्र. सं.	उद्योग	पैरामीटर	मानक		
(1)	(2)	(3)	(4)		
			अ. चिमनी प्रणाली से उत्सर्जन		
	"(फर्नेस, बॉयलर, हीटर, वाष्पीकारक)		सान्द्रण सीमा मि.ग्रा./नार्मल घनमीटर, यदि उल्लिखित न हो		
			ईंधन की किस्म	विद्यमान उपक्रम	नये उपक्रम/विद्यमान उपक्रमों का विस्तार
		सल्फर डाईऑक्साइड (SO_2)	गैस	50	50
			तरल	1700	850
		नाईट्रोजन के आक्साईड (NO_x)	गैस	350	250
			तरल	450	350
		विविक्त कण (PM)	गैस	10	05
			तरल	100	50
		कार्बन मोनो आक्साईड (CO)	गैस	150	100
			तरल	200	150

टिप्पणी.—(i) सभी मानों को 3% आक्सीजन पर ठीक किया जाए ।

(2) डिकोकिंग के समय पर वैट स्क्रूबर आवश्यक रूप से संचालित किया जाए ।

(3) कार्बन मोनो आक्साइड के मानक केवल थैलिक एन्हाइड्राइड (PA) मेलेइक एन्हाइड्राइड (MA) टेरीथैलिक अम्ल (PTA) और डाइमिथाइल टेरेफ्लेट (DMT) उपक्रमों के मामले में ही प्रबोधित किए जाएं । कार्बन मोनो आक्साइड के मानक अकेले PA/MA उत्पादन करने हेतु स्थापित क्षमता 30,000 टन प्रति वर्ष से कम की निर्वतमान इकाई में लागू नहीं होंगे, यदि इस प्रकार की इकाई कार्बन मोनो आक्साइड के उत्सर्जन के लिए कम से कम 30 मीटर ऊंचाई की चिमनी प्रणाली हो ।

(1)	(2)	(3)	(4)		
		प्रक्रमण उत्सर्जन (विशेष प्रदूषक)			
			स्त्रोत	सान्द्रण सीमा मि.ग्रा./ नार्मल घन मीटर में	
				निवर्तमान प्लांट	नये प्लांट
		क्लोरीन	ईडीसी/वीसीएम प्लांट तथा भस्मित्र	10	10
		हाइड्रोक्लोरिक अम्ल का कोहरा	ईडीसी/वीसीएम प्लांट तथा भस्मित्र	30	30
		अमोनिया	अपशिष्ट जल स्ट्राइपर, एक्रीलोनीट्राइल प्लांट, केप्रोलेक्टम प्लांट	75	75
		हाइड्रोजन सल्फाईड	नेपथा प्रिट्रीटमेन्ट, ओल्फिन प्लांट	05	05
		फॉसजीन	(टीडीआई) और (एमवीआई) प्लांट	01	01
		हाइड्रोजन साइनाईड (HCN)	एक्रीलोनीट्राइल प्लांट	10	10
		वीओसी(HAPs)-टीडीआई और एमडीआई	टीडीआई, मिथाइलीनडिफिनायल डाई-ईसोसाइनेट (एमडीआई) प्लांट	0.1	0.1
		वीओसी (HAPs), बैंजीन और बुटाडाईन	बैंजीन, बुटाडाईन प्लांट	5.0	5.0
		वीओसी (HAPs), ईओ, वीसीएम, ईडीसी, एसीएन और पीओ	ईओ,वीसीएम, ईडीसी, एसीएन, पीओ प्लांट	20.0	10.0
		कार्बनिक विवित्त कण	पीए, एमए और टीडीआई प्लांट	50	25
		प्रक्रम उत्सर्जन (सामान्य प्रदूषक)			
			स्रोत	सान्द्रण सीमा मि.ग्रा./ नार्मल घन मीटर में	
		वीओसी (एमए, पीए और फिनोल)	एमए, पीए, फिनॉल प्लांट	20	
		वीओसी(ईबी, स्ट्राइन, टाल्विन, जाइलीन, एरोमेटिक्स, ईजी और पीजी)	इथाइल बैंजिन (ईबी), स्ट्राइन, टाल्विन, जाइलीन, एरोमेटिक्स, ईजी, पीजी प्लांट	100	
		वीओसी (पैराफिन, ऐसीटान और ओल्फिन)	नॉन-मिथेन, एचसी (पैराफिन), ऐसीटान, औल्फि प्लांट	150	

टिप्पण.—

HAP- परिसंकटमय वायु प्रदूषक कैंसरजन्य होते है अथवा अन्य गंभीर स्वास्थ्य प्रभावों अथवा पर्यावरणीय और इकोलोजिकल प्रभावों पर प्रतिकूल असर डालते है ।

इ. प्लायक उत्सर्जन के लिए मानक

वाष्पशील द्रव का भण्डारण: साधारण पेट्रोकेमिकल/पेट्रोलियम उत्पाद

(1) 4 से 75 घनमीटर के बीच की क्षमता वाले भण्डारण टैंक और कुल वाष्प दबाव दस किलो पास्कल से अधिक होने पर, इसकी छत स्थायी होगी तथा प्रेशर वाल्व निकास सहित होना चाहिए ।

(2) 75 से 500 घनमीटर की क्षमता वाले भण्डारण टैंक और कुल वाष्प दबाव 10 से 76 किलो पास्कल के बीच होने पर, इसकी छत आन्तरिक तैरती अथवा वाह्य तैरती होगी और वाष्प की रोकथाम अथवा वाष्प सन्तुलन प्रणाली सहित स्थायी होनी चाहिए ।

(3) 500 घनमीटर से अधिक क्षमता वाले भण्डारण टैंक और कुल वाष्प दबाव 10 से 76 किलो पास्कल के बीच होने पर, इसकी छत आन्तरिक तैरती अथवा वाह्य तैरती होगी और वाष्प रोकथाम प्रणाली सहित स्थायी होनी चाहिए ।

(4) 75 घनमीटर से अधिक क्षमता वाले टैंक और कुल वाष्प दबाव 76 किलो पास्कल से अधिक होने पर, इसकी छत स्थायी और वाष्प रोकथाम प्रणाली सहित होनी चाहिए ।

(5) फ्लोटिंग छत वाली टंकियों को सील करने की आवश्यकता:

(i) (क) टंकी की आन्तरिक फ्लोटिंग छत और वाहय फ्लोटिंग छत 96% की न्यूनतम वाष्प की पुन: प्राप्ति प्रणाली सहित दो सील मुहैया करायी जायेगी ।

(ख) बाहय फ्लोटिंग छत की मूल सील तरल रूप में अथवा जूते की तरह मढी होगी और आन्तरिक फ्लोटिंग छत मढी होगी । सील अन्तराल की अधिकतम् चौड़ाई 4 से.मी. होगी और अधिकतम् अन्तराल क्षेत्र टैंक के व्यास का 200 वर्ग से.मी./मीटर होगा ।

(ग) गौण सील रिम पर मढी होगी । सील अन्तराल की अधिकतम् चौड़ाई 1.3 से.मी. होगी और अधिकतम् अन्तराल क्षेत्र टैंक के व्यास का 20 वर्ग से.मी./मीटर होगा ।

(घ) सील की सामग्री और निर्माण उच्चतम् निष्पादन स्थाईत्व वाला हो, ऐसा सुनिश्चित किया जायेगा ।

(ii) स्थायी छत वाले टैंक की वाष्प नियंत्रण कुशलता 95% होगी और वाष्प सन्तुलन कुशलता 90% होगी ।

(iii)(क) भण्डारण टैंकों का निरीक्षण और रख-रखाव कड़े नियंत्रण के अधीन होगा।

(ख) निरीक्षण के लिए **API RP 575** को अपनाया जाय ।

(ग) सेवा के दौरान सील गैप के संबंध में निरीक्षण छः महीने में एक बार किया जायेगा और मरम्मत अल्प समय में की जायेगी ।

(घ) भविष्य में दोनों सीलों की मरम्मत की संभावना की जांच पड़ताल उत्पादन जारी रहने के दौरान की जायेगी ।

(iv) स्पष्टतया संवेदनशील क्षेत्र अथवा प्रतिष्ठा को छोड़कर भण्डारण टंकी को सफेद रंग से पेन्ट किया जाय ।

ई. बेन्जीन, वीसीएम तथा एसीएन का भण्डारण

(1) स्थायी छत वाले टैंक में भस्मीकरण के वाष्प के लिए वाष्पशील कार्बनिक यौगिकों (VOC) की पृथक्करण क्षमता 99.9% हो, प्रदान की जायेगी; अथवा

(2) टंकी की आन्तरिक तैरती छत/बाह्य तैरती छत (आईएफआरटी/ईएफआरटी) दोहरी सीलों, उत्सर्जन न्यूनीकरण छत की साज सज्जा और जो स्थायी छत के साथ वाष्प पृथक्करण क्षमता कम से कम 99% हो, प्रदान की जायेगी; **अथवा**

(3) स्थायी और तैरती छत के बीच आन्तरिक तैरती छत और नाइट्रोजन आवरण को लगाया जाये।

(सड़क के टैंक, ट्रक/रेल टैंक, वैगन भराई के लिए उत्सर्जन नियंत्रण)			
	वाष्पशील उत्पादों की भराई	नेपथा:	
		(i) VOC कटौती,%	(i)≥99.5
		अथवा	अथवा
		(ii) उत्सर्जन, ग्राम/घनमीटर	(ii)≤5
		बेन्जीन तथा ब्यूटाडाइन:	
		(i) VOC कटौती,%	(i)≥99.99
		अथवा	अथवा
		(ii) उत्सर्जन, मिग्रा/घनमीटर	(ii)≤20
		टाल्विन/जाइलीन:	
		(i) VOC कटौती,%	(i)≥99.98
		अथवा	अथवा
		(ii) उत्सर्जन, मि.ग्रा./घनमीटर	(ii)≤150 "।

(ख) अनुसूची vi, सामान्य उत्सर्जन मानक - भाग – डी में, III. भार/मात्रा आधारित मानक की प्रविष्टियों में - क्रम संख्या 8 "ग्लास उद्योग" तथा उससे संबंधित प्रविष्टयों के पश्चात् निम्नलिखित क्रम संख्यांक और प्रविष्टियां रखी जायेगी, अर्थात् :-

क्र.सं.	उद्योग	पैरामीटर	मानक	
"9	पैट्रोकेमिकल्स (आधारभूत और माध्यमिक)		स्रोत	नये/विस्तारण प्लाटों में मात्रा सीमा (ग्रा./घण्टे)
		कार्बनिक विविक्त कण	थेलिक एनहाइड्राइड (पी.ए.) मेलेइक एनहाइड्राइड (एम.ए) टाल्विन-डाइ-आइसोसाइनेट (टी.डी.आई.) प्लांट प्रक्रम उत्सर्जन	100
		VOC-HAPs (टीडीआई, एमडीआई)	टाल्विन-डाई-आइसोसाइनेट (टी.डी.आई.) मिथाइलीन डाईफिनॉइल, डाइसोनाइनेट (एमडीआई) प्लांट प्रक्रम उत्सर्जन	0.5
		VOC-HAPs (बेन्जीन ब्यूटाडाईन)	बेन्जीन, ब्यूटाडाईन प्लांट प्रक्रम उत्सर्जन	25.0
		VOC-HAPs (ईओ, वीसीएम, ईडीसी, एसीएन, पीओ)	ईओ, वीसीएम, ईडीसी, एसीएन, पीओ प्लांट - प्रक्रम उत्सर्जन	50.0

संक्षिप्त अक्षर: ईजी- ईथाइलीन ग्लाइकोल, पीजी-प्रोपिलीन ग्लाइकोल, ईओ-ईथाइलीन आक्साइड, वीसीएम-विनायल क्लोराइड मोनोमर, ईडीसी-ईथाइलीन डाइ क्लोरीन, एसीएन-एक्राइलोनाइट्राइल, पीओ, प्रोपीलीन आक्साइड, एचसीएन-हाइड्रोजन साइनाइड "।

[फा. सं. क्यू.-15017/12/2008-सी.पी.डब्ल्यू.]

अजय त्यागी, संयुक्त सचिव

टिप्पण.—मूल अधिसूचना भारत के राजपत्र में का.आ. 844(अ), तारीख 19 नवम्बर, 1986 के द्वारा प्रकाशित की गई थी और इसके पश्चात सं. का.आ.433 (अ) तारीख 18 अप्रैल 1987; और अभी हाल में सा.का.नि 512 (अ), तारीख 9 जुलाई 2009; सा.का.नि 543 (अ), तारीख 22 जुलाई 2009; सा.का.नि 595 (अ) तारीख 21 अगस्त 2009; सा.का.नि 794 (अ) तारीख 4 नवम्बर 2009; सा.का.नि 826 (अ) तारीख 16 नवम्बर 2009; सा.का.नि 01 (अ) तारीख 1 जनवरी 2010; सा.का.नि 61 (अ) तारीख 5 फरवरी 2010; सा.का.नि 485 (अ) तारीख 9 जून 2010; सा.का.नि 608 (अ) तारीख 21 जुलाई 2010; सा.का.नि 739 (अ) तारीख 9 सितम्बर 2010; सा.का.नि 809 (अ) तारीख 4 अक्टूबर 2010; सा.का.नि 215 (अ) तारीख 15 मार्च 2011; सा.का.नि 221 (अ) तारीख 18 मार्च 2011; सा.का.नि 354 (अ) तारीख 2 मई 2011; सा.का.नि 424 (अ) तारीख 1 जून 2011; सा.का.नि 446 (अ) तारीख 13 जून 2011; सा.का.नि. 152 (अ) तारीख 16 मार्च 2012; सा.का.नि. 266 (अ) तारीख 30 मार्च 2012 और सा.का.नि. 277 (अ) तारीख 31 मार्च 2012 के द्वारा उसमें संशोधन किये गये।

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 9th November, 2012

G.S.R. 820(E).— In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:-

1. (1) These rules may be called the Environment (Protection) Fourth Amendment Rules, 2012.
   (2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986,-

   (a) in Schedule I, in the entries against serial number 38 relating to 'Petrochemical (Basic and Intermediates),-

   (i) in the entries under column 2, for the word "EFFLUENT", the letter and word "A. Effluent" shall be substituted;
   (ii) at the end, the following entries shall be inserted, namely:-

S. No.	Industry	Parameter	Standards		
(1)	(2)	(3)	(4)		
B. Emission from Chimney / Stack					
			Limiting concentration in mg/Nm^3, unless stated		
			Fuel Type	**Existing Plants**	**New plants / Expansion of Existing Plant**
	"(Furnace, Boiler, Heater, Vaporiser)	Sulphur Dioxide (SO_2)	Gas	50	50
			Liquid	1700	850
		Oxides of Nitrogen (NOx)	Gas	350	250
			Liquid	450	350
		Particulate Matter (PM)	Gas	10	05
			Liquid	100	50

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(1)	(2)	(3)	(4)		
		Carbon Monoxide (CO)	Gas	150	100
			Liquid	200	150
		Note,- (i) All values shall be corrected to 3% Oxygen. (ii) Wet scrubber shall necessarily be operated at the time of decoking. (iii) Norms for CO shall be monitored only in case of Phthalic Anhydride (PA), Maleic Anhydride (MA), Terephthalic Acid (PTA) and Dimethyl Terephalate (DMT) Plants. Norms for CO emissions shall not be applicable to PA/ MA manufacturing standalone existing plants with an installed capacity of less than 30,000 metric tonnes per annum, provided that such units have a chimney/stack of minimum 30 metres height for emitting Carbon Monoxide.			

Process Emission (Specific Pollutant)

	Source	Limiting concentration in mg/Nm^3	
		Exiting Plants	New Plants
Chlorine	EDC/VCM Plant and Incinerator	10	10
Hydrochloric Acid Mist	EDC / VCM Plant and Incinerator	30	30
Ammonia	Wastewater stripper, acrylonitrile plant, caprolactum plant	75	75
Hydrogen Sulphide	Naphtha pre-treatment plant, olefin plant	05	05
Phosgene	(TDI) and (MDI) plant	01	01
Hydrogen Cyanide(HCN)	Acrylonitrile plant	10	10
VOC (HAPs)- TDI and MDI	TDI, Methylenediphenyl Di-isocyante (MDI) Plants	0.1	0.1
VOC (HAPs), Benzene and Butadiene	Benzene, Butadiene Plants	5.0	5.0
VOC (HAPs), EO, VCM, EDC, ACN and PO	EO, VCM, EDC, ACN, PO Plants	20.0	10.0
Organic Particulate	PA, MA and TDI Plants	50	25

Process Emission (General Pollutant)

	Source	Limiting concentration in mg/Nm^3
VOC (MA, PA and Phenol)	MA, PA, Phenol Plants	20
VOC (EB, Styrene, Toluene, Xylene, Aromatics, EG and PG)	Ethyl benzene (EB), Styrene, Toluene, Xylene, Aromatics, EG, PG Plants	100
VOC (paraffin, Acetone and Olefins)	Non-methane, HC (paraffin), Acetone, Olefins Plants	150

NOTE— HAP – Hazardous Air Pollutants are those pollutants that cause cancer or other serious health effects, or adverse environmental and ecological effects.

C. Standards for Fugitive Emission

Storage of Volatile Liquids: General Petrochemical / Petroleum Products.

(1) Storage tanks with capacity between 4 to 75m^3 and total vapour pressure (TVP) of more

(2) Storage tanks with capacity between 75 to 500 m^3 and total vapour pressure (TVP) of 10 to 76 kpa should have internal floating roof or external floating roof or fixed roof with vapour control or vapour balancing system.

(3) Storage tanks with the capacity of more than 500 m^3 and total vapour pressure (TVP) of 10 to 76 kpa should have internal floating roof or external floating roof or fixed roof with vapour control system.

(4) The tanks with the capacity of more than 75 m^3 and total vapour pressure (TVP) of more than 76 kpa should have fixed roof with vapour control system.

(5) Requirement for seals in Floating Roof Tanks-

(i) (a) Internal Floating Roof Tank (IFRT) and External Floating Roof Tank (EFRT) shall be provided double seals with minimum vapour recovery of 96%.

(b) Primary seal shall be liquid or shoe mounted for EFRT and vapour mounted for IFRT. Maximum seal gap width will be 4 cm and maximum gap area will be 200 cm^2/m of tank diameter.

(c) Secondary seal shall be rim mounted. Maximum seal gap width will be 1.3 cm and maximum gap area will be 20 cm^2 /m of tank diameter.

(d) Material of seal and construction shall ensure high performance and durability.

(ii) Fixed roof tanks shall have vapour control efficiency of 95% and vapour balancing efficiency of 90%.

(iii) (a) inspection and maintenance of storage tanks shall be carried out under strict control;
(b) for the inspection, API RP 575 may be adopted;
(c) In-service inspection with regard seal gap should be carried out once in every six months and repair to be implemented in short time; and
(d) the possibility of on-stream repair of both shall be examined.

(iv) Storage tanks shall be painted with white colour shade, except for derogation of visually sensitive area.

D. Storage of Benzene, VCM and ACN

(i) FRT with vapour for incineration with 99.9% of removal efficiency for volatile organic compounds (VOC) shall be provided; or

(ii) IFRT/EFRT with double seals, emission-reducing roof fitting and fitted with fixed roof with vapour removal efficiency of at least 99% shall be provided; or

(iii) Internal floating roof and nitrogen blanketing in between fixed and floating roofs shall be provided.

(Emission control for Road tank, truck / Rail tank, wagon loading)			
	Loading of Volatile Products	Naphtha: (i) VOC reduction, % or (ii) Emission, gm/m^3	(i) $\geq$99.5 or (ii) $\leq$5
		Benzene and Butadiene: (i) VOC reduction, % or (ii) Emission, mg/m^3	(i) $\geq$99.99 or (ii) $\leq$ 20
		Toluene/Xylene: (i) VOC reduction, % or (ii) Emission, mg/m^3	(i) $\geq$99.98 or (ii) $\leq$ 150.".

(b) in Schedule VI, in Part D relating to General Standards, in the entries under item III relating to Load/Mass based Standards, after serial number 8 relating to 'Glass Industry' and entries relating thereto, the following serial number and entries shall be inserted, namely :-

S. No.	Industry	Parameter	Standard	
"9	Petrochemicals (Basic and Intermediates)		Source	Quantum limit in gm/hour for New/ Expansion Plants (gm/hr)
		Organic Particulate	Phthalic anhydride (PA), Maleic anhydride (MA), Toluene Di-isocyanate (TDI) plants – process emission	100
		VOC-HAPs (TDI + MDI)	(Toluene Di-isocyate) TDI, Methylenediphenyl Di-isocyante (MDI) Plants-Process emission	0.5
		VOC-HAPs (Benzene + Butadiene)	Benzene, Butadiene Plants – Process emission	25.0
		VOC-HAPs (EO, VCM, EDC, ACN + PO)	EO, VCM, EDC, ACN, PO Plants – Process emission	50.0

Abbreviations: EG – Ethylene Glycol, PG – Propylene Glycol, EO – Ethylene Oxide, VCM – Vinyl Chloride Monomer, EDC – Ethylene Di Chloride, ACN – Acrylonitrile, PO – Propylene Oxide, HCN – Hydrogen Cyanide.".

[F. No. Q-15017/12/2008-CPW]

AJAY TYAGI, Jt. Secy.

Note.— The principal rules were published in the Gazette of India vide number S.O. 844 (E), 19th November, 1986 and subsequently amended vide notifications numbers S.O. 433 (E), dated 18th April 1987; G.S.R. 97 (E), dated the 18th February, 2009; G.S.R. 149 (E), dated the 4th March , 2009; G.S.R. 512 (E), dated the 9th July, 2009;G.S.R. 543 (E), dated the 22nd July, 2009; G.S.R. 595 (E), dated the 21st August, 2009; G.S.R. 794 (E), dated the 4th November, 2009; G.S.R. 826 (E), dated the 16th November, 2009; G.S.R. 01 (E), dated the 1st January, 2010; G.S.R. 61 (E), dated the 5th February, 2010; G.S.R. 485 (E), dated the 9th June, 2010; G.S.R. 608 (E) ,dated the 21st July, 2010; G.S.R. 739 (E), dated the 9th September, 2010; G.S.R. 809(E), dated, the 4th October, 2010, G.S.R. 215 (E), dated the 15th March, 2011; G.S.R. 221(E), dated the 18th March, 2011; G.S.R. 354 (E), dated the 2nd May, 2011; G.S.R. 424 (E), dated the 1st June, 2011; G.S.R. 446 (E), dated the 13th June, 2011; G.S.R. 152 (E), dated the 16th March, 2012; G.S.R. 266(E), dated the 30th March, 2012; and G.S.R. 277 (E), dated the 31st March, 2012.

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भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)
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सं. 468] नई दिल्ली, शुक्रवार, अगस्त 21, 2009/श्रावण 30, 1931
No. 468] NEW DELHI, FRIDAY, AUGUST 21, 2009/SRAVANA 30, 1931

पर्यावरण एवं वन मंत्रालय

अधिसूचना

नई दिल्ली, 21 अगस्त, 2009

सा.का.नि. 595(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6 और धारा 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, पर्यावरण (संरक्षण) नियम, 1986 का और संशोधन करने के लिए निम्नलिखित नियम बनाती है, अर्थात्:-

1. (1) इन नियमों का संक्षिप्त नाम पर्यावरण (संरक्षण) पाचंवा संशोधन नियम, 2009 है ।
(2) ये राजपत्र में प्रकाशन की तारीख को प्रवृत्त होंगे ।

2. पर्यावरण संरक्षण नियम, 1986 की अनुरूची V। के सामान्य मानक से संबंधित भाग घ : भार/सहंति आधारित मानकों से संबंधित मद-3 के अधीन प्रविष्यिों में 'तेल परिष्करणी' से संबधित क्रम संख्यांक 6 और संबंधित प्रविष्टियों के स्थान पर निम्नलिखित क्रम संख्यांक और प्रविष्टियाँ रखी जाएंगी, अर्थात् :-

क्र.सं.	उद्योग	पेरामीटर	मानक		
1	2	3	4		
"6	पेट्रोलियम तेल परिष्करणी (सल्फर रिकवरी)		सल्फर रिकवरी यूनिट की स्थापित क्षमता (टन/दिन)	सल्फर रिकवरी यूनिट के फीड में सल्फर की मात्रा किलोग्राम/टन में	
				विद्यमान यूनिट	नया यूनिट
		सल्फर डाई आक्साइड	20 से अधिक	26	10
			5 से 20	80	40
			5 तक	120	80"

[फा. सं. क्यू-15017/15/2007-सी.पी.डब्ल्यू.]

रजनीश दुबे, संयुक्त सचिव

टिप्पण : मूल नियम भारत के राजपत्र में का.आ.सं. 844(अ) तारीख 19 नवम्बर, 1986 के द्वारा प्रकाशित किए गए थे और पश्चातवर्ती संशोधन का.आ.सं. 433(अ), तारीख 18 अप्रैल, 1987; का.आ.सं. 64(अ), तारीख 18 जनवरी, 1988; का.आ.सं. 3(अ), तारीख 3 जनवरी, 1989; का.आ.सं. 190(अ), तारीख 15 मार्च, 1989; सा.का.नि. 913(अ), तारीख 24 अक्टूबर, 1989; का.आ.सं. 12(अ), तारीख 8 जनवरी, 1990; सा.का.नि. 742(अ), तारीख 30 अगस्त, 1990; का.आ.सं. 23(अ), तारीख 16 जनवरी, 1991; का.आ.सं. 93(अ), तारीख 21 फरवरी, 1991; सा.का.नि. 95(अ), तारीख 12 फरवरी, 1992; सा.का.नि. 797(अ), तारीख 1 अक्टूबर, 1992; सा.का.नि. 386(अ), तारीख 28 अप्रैल, 1993; सा.का.नि. 422(अ), तारीख 19 मई 1993; सा.का.नि. 801(अ), तारीख 31 दिसम्बर, 1993; सा.का.नि. 176(अ), तारीख 3 अप्रैल, 1996, सा.का.नि. 631(अ), तारीख 31 अक्टूबर, 1997; सा.का.नि. 504(अ), तारीख 20 अगस्त; 1998, सा.का.नि. 7(अ), तारीख 2 जनवरी, 1999; सा.का.नि. 682(अ), तारीख 6 अक्टूबर, 1999; सा.का.नि. 742(अ), तारीख 25 सितम्बर, 2000; सा.का.नि. 72(अ), तारीख 6 फरवरी, 2001; सा.का.नि. 54(अ), तारीख 22 जनवरी, 2002; सा.का.नि. 371(अ), तारीख 17 मई, 2002; सा.का.नि. 489(अ), तारीख 9 जुलाई, 2002; सा.का.नि. 1088(अ), तारीख 11 अक्टूबर, 2002; सा.का.नि. 849(अ), तारीख 30 दिसम्बर, 2002; सा.का.नि. 520(अ), तारीख 1 जुलाई, 2003; सा.का.नि. 92(अ), तारीख 29 जनवरी, 2004; सा.का.नि. 448(अ), तारीख 12 जुलाई, 2004; शुद्धिपत्र सा.का.नि. 520(अ), तारीख 12 अगस्त, 2004; सा.का.नि. 272(अ), तारीख 5 मई, 2005; सा.का.नि. 315(अ), तारीख 16 मई, 2005; सा.का.नि. 546(अ), तारीख 30 अगस्त, 2005; सा.का.नि. 46(अ), तारीख 3 फरवरी, 2006; सा.का.नि. 464(अ), तारीख 7 अगस्त, 2006; सा.का.नि. 640(अ), तारीख 16 अक्टूबर, 2006; सा.का.नि. 566(अ), तारीख 29 अगस्त, 2007; सा.का.नि. 704(अ), तारीख 12 नवम्बर, 2007;सा.का.नि. 186(अ), तारीख 18 मार्च, 2008; सा.का.नि. 280(अ), तारीख 11 अप्रैल, 2008; सा.का.नि. 344(अ), तारीख 7 मई, 2008; सा.का.नि. 414(अ), तारीख 30 मई, 2008; सा.का.नि.481(अ), तारीख 26 जून, 2008, सा.का.नि. 579 (अ), तारीख 6 अगस्त, 2008; सा.का.नि.. 600(अ), तारीख 18 अगस्त, 2008; सा.का.नि.. 752(अ), तारीख 24 अक्टूबर, 2008; सा.का.नि. 844(अ), तारीख 18 फरवरी, 2009; सा.का.नि. 149(अ), तारीख 4 मार्च, 2009; सा.का.नि. 512(अ), तारीख 8 जुलाई; 2009; और सा.का.नि. 543 (अ), 22 जुलाई, 2009 प्रकाशित किये गये हैं ।

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 21st August, 2009

G.S.R. 595(E).—In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:-

1. (1) These rules may be called the Environment (Protection) Fifth Amendment Rules, 2009.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule – VI, in Part D relating to General Standards, in the entries under item III relating to Load / Mass Based Standards, for serial number 6 relating to 'Oil Refineries' and entries relating thereto, the following serial number and entries shall be substituted, namely :-

S.No.	Industry	Parameter	Standard		
1	2	3	4		
"6	Petroleum Oil Refinery (Sulphur Recovery)		Installed Capacity of SRU* (tonne/day)	Kg / tonne of sulphur in the feed to SRU	
				Existing SRU	New SRU
		Sulphur Dioxide	above 20	26	10
			5 to 20	80	40
			up to 5	120	80

* SRU – Sulphur Recovery Unit".

[F. No. Q-15017/15/2007-CPW]

RAJNEESH DUBE, Jt. Secy.

Note : - The principal rules were published in the Gazette of India, Extraordinary vide number S.O. 844 (E), dated the 19th November, 1986 and subsequently amended vide S.O. 433 (E), dated the 18th April, 1987; S.O. 64 (E), dated the 18th January, 1988; S.O. 03 (E), dated the 3rd January, 1989; S.O. 190 (E), dated the 15th March, 1989; G.S.R. 913 (E), dated the 24th October, 1989; S.O. 12 (E), dated the 8th January, 1990; G.S.R. 742 (E), dated the 30th August, 1990; S.O. 23 (E) ,dated the 16th January, 1991; G.S.R. 93 (E), dated the 21st February, 1991; G.S.R. 95 (E), dated the 12th February, 1992; G.S.R. 329 (E), dated the 13th March, 1992; G.S.R. 475 (E), dated the 5th May, 1992; G.S.R. 797 (E), dated the 1st October, 1992; G.S.R. 386 (E), dated the 28th April, 1993; G.S.R. 422 (E), dated the 19TH May, 1993; G.S.R. 801 (E), dated the 31st December, 1993; G.S.R. 176 (E), dated the 3rd April, 1996; G.S.R. 631 (E) ,dated the 31st October, 1997; G.S.R. 504 (E), dated the 20th August, 1998; G.S.R. 7 (E), dated the 2nd January, 1999; G.S.R. 682 (E), dated the 6th October, 1999; G.S.R. 742 (E), dated the 25th September, 2000; G.S.R. 72 (E), dated the 6th February, 2001; G.S.R. 54 (E), dated the 22nd January, 2002; G.S.R. 371 (E), dated the 17th May, 2002; G.S.R. 489 (E), dated the 9th July, 2002; S.O. 1088 (E) , dated the 11th October, 2002; G.S.R. 849 (E), dated the 30th December, 2002; G.S.R. 520 (E), dated the 1st July, 2003; G.S.R. 92 (E), dated the 29th January, 2004; G.S.R. 448 (E), dated the 12th July, 2004; Corrigenda G.S.R. 520 (E), dated the 12th August ,2004; G.S.R. 272 (E), dated the 5th May, 2005; G.S.R. 315 (E), dated the 16th May, 2005; G.S.R. 546 (E), dated the 30th August, 2005; G.S.R. 46 (E), dated the3rd February, 2006; G.S.R. 464 (E), dated the 7th August, 2006; G.S.R. 640 (E), dated the 16th October, 2006; G.S.R. 566 (E), dated the 29th August, 2007; G.S.R. 704 (E), dated the 12th November, 2007; G.S.R. 186 (E), dated the 18th March, 2008; G.S.R. 280 (E), dated the 11th April 2008; G.S.R. 344 (E), dated the 7th May, 2008; G.S.R. 414 (E), dated the 30th May, 2008; G.S.R. 481 (E), dated the 26th June, 2008; G.S.R. 579 (E), dated the 6th August, 2008; G.S.R. 600 (E), dated the 18th August, 2008; G.S.R. 752 (E), dated the 24th October 2008; G.S.R. 97 (E), dated the 18th February, 2009; G.S.R. 149 (E), dated the 4th March, 2009; G.S.R. 512 (E), dated the 9th July, 2009; and G.S.R. 543(E), dated the 22nd July, 2009.

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"Annexure 2"

भारत का राजपत्र
The Gazette of India

असाधारण
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भाग II—खण्ड 3—उप-खण्ड (ii)
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सं. 1962] नई दिल्ली, बृहस्पतिवार, अगस्त 22, 2013/श्रावण 31, 1935
No. 1962] NEW DELHI, THURSDAY, AUGUST 22, 2013/SHRAVANA 31, 1935

पर्यावरण और वन मंत्रालय

अधिसूचना

नई दिल्ली, 22 अगस्त, 2013

का.आ. 2561(अ).—जबकि समुद्री राष्ट्रीय उद्यान तथा समुद्री अभयारण्य के चारों ओर 326.26 वर्ग किलोमीटर कुल क्षेत्र को पारिस्थितिक संवेदनशील जोन की पहचान की गई है, जिसमें से 208.58 वर्ग किलोमीटर क्षेत्र भूमि की दिशा में, 105.14 वर्ग किलोमीटर समुद्र की दिशा में और 12.5384 वर्ग किलोमीटर क्षेत्र तथा नदी द्वारा घिरा हुआ है और 457.92 वर्ग किलोमीटर का क्षेत्र समुद्री अभयारण्य से घिरा हुआ है और 162.89 वर्ग किलोमीटर के क्षेत्र को वर्ष 1982 में समुद्री राष्ट्रीय उद्यान के रूप में अधिसूचित किया गया था तथा जामनगर जिले के खाड़ी का संपूर्ण दक्षिणी तट 42 द्वीप समूहों से गोलाकार रूप से घिरा हुआ है व उनमें से अनेक मूंगों की समुद्री चट्टान और कच्छ वनस्पति पेड़ पौधों से घिरे हुए हैं;

और, कच्छ की खाड़ी में उच्च घनत्व और विविधता, विभिन्न प्रकार के प्राकृतिक आवास जैसे रेतीला, गदला, चट्टानी समुद्र तल व मूंगा तल व नमभूमि जंगल के कारण है। "समुद्र का वह भाग जो कि भागतः संकीर्ण तट से घिरा होता है और अपेक्षाकृत मुख की तरफ संकीर्ण व अंदर में फैलाव होता है", को खाड़ी के रूप में परिभाषित किया गया है।

और, कच्छ की खाड़ी "इण्डो मलायन परिमंडल तट" जैव-भौगोलिक क्षेत्र में अवस्थित है, जिसे संघ का प्राकृतिक संरक्षित क्षेत्र श्रेणी-1 के संरक्षण के लिए अंतरराष्ट्रीय संघ के रूप में विचार करना होगा;

और, समुद्री राष्ट्रीय उद्यान की वनस्पति मुख्यतः नमभूमि वनस्पति व विभिन्न समुद्रिक शैवाल जिसके अंतर्गत व्यावसायिक रूप से महत्वपूर्ण प्रजातियां जैसे ऐगारोफाइटिस और एलीजीनोफाइटिस भी सम्मिलित हैं तथा खाड़ी तट रेखा के किनारे ऐवीसिनीया, रीजोफोराए व नमभूमि वनस्पति सेरीपोस प्रजाति से भरा हुआ है और उक्त क्षेत्र में कुछ क्षेत्रीय प्रजाति जैसे कि सलवाडोरा, जीजीपस व प्रोसोपिस प्रजाति पाए जाते हैं;

और, 70 स्पंज प्रजाति, कठोर मूंगा की 37 प्रजातियां व कोमल मूंगा की 24 प्रजातियां, मछली की 150-200 प्रजातियां, झींगों की 27 प्रजातियां, केकड़ों की 30 प्रजातियां, मोलस्क की 200 प्रजातियां, समुद्री कछुवों की 3 प्रजातियां और समुद्री सांप की 3 प्रजातियां, समुद्री स्तनधारी की 3 प्रजातियां, जलीय पक्षी की 94 प्रजातियां और क्षेत्रीय पक्षियों की 78 प्रजातियां समुद्री अभयारण्य में पाये जाते हैं;

और, अनेक विकासात्मक क्रियाकलाप जिसके अंतर्गत औद्योगिक, बंदरगाह, अवसंरचना और मछली पकड़ना आदि भी हैं, समुद्री राष्ट्रीय उद्यान तथा समुद्री अभयारण्य के आस-पास चल रहे हैं और जिसका प्रतिकूल पर्यावरण प्रभाव समुद्री राष्ट्रीय उद्यान तथा समुद्री अभयारण्य पर पड़ रहा है, समुद्री राष्ट्रीय उद्यान तथा समुद्री अभयारण्य के संरक्षित क्षेत्र के चारों ओर के क्षेत्र संरक्षण व उसकी सुरक्षा आवश्यक है ताकि पारिस्थितिकी और पर्यावरणीय दृष्टि से पर्यावरण व पारिस्थितिक संवेदनशील जोन के रूप में इसके भीतर या इसके पर्यावरण में वन्यजीवों का संरक्षण, प्रसार या विकसित हो सके;

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29.	पारंपरिक शैति से मछली	–	–	हां	राज्य में विद्यमान निबंधनों और विद्यमान विधियों के साथ अनुज्ञात
30.	लवण का क्रियाकलाप	–	हां	–	–
31.	समुद्री जल की निकासी	–	हां	–	यह प्रवृत्त विधि के अनुसार विद्यमान उद्योगों का अनुज्ञात होगा।
32.	क्षेत्र या उपसतह पर प्रवहण प्रणाली और पाइप लाइनों (तेल और गैस, समुद्री जल को ग्रहण करने, उपचारित बहिस्राव) का निर्माण करना	–	हां	–	क्रियाकलाप जैसे क्षेत्र या उपसतह पर प्रवहण प्रणाली और पाइप लाइनों (तेल और गैस, समुद्री जल को ग्रहण करने, उपचारित बहिस्राव) का निर्माण करने में प्रस्तावित पारिस्थितिकी संवेदनशील जोन में पहले से ही विद्यमान सभी अवसंरचनात्मक और सुविधाओं को क्रियाकलापों के रूप में विनियतिम करना भी है

[फा. सं. 25/2/2012–ईएसजेड/आरई]

डॉ. जी. वी. सुब्रह्मण्यम, वैज्ञानिक 'जी'

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 22nd August, 2013

S.O. 2561(E).—Whereas, the total area of 326.26 square kilometre around Marine National Park and Marine Sanctuary has been identified as Eco-sensitive zone, of which 208.5818 square kilometre is the area towards landward side, 105.14 square kilometer towards sea and 12.5384 square

kilometer is the area covered by rivers and the Marine Sanctuary covers an area of 457.92 square kilometre and an area of 162.89 square kilometre as Marine National Park was notified in 1982 and the entire Southern Coast of the Gulf in Jamnagar district is ringed by a cluster of 42 islands and many of them are fringed by coral reefs and mangrove vegetation;

And whereas, the high density and diversity in the Gulf of Kutch is due to the availability of different types of habitats like sandy, muddy, rocky, calcareous sea bed and coral beds and mangroves in the relatively sheltered waters of the Gulf and is defined as "portion of sea partially enclosed by sweep of coast and usually narrower at mouth than bay";

And whereas, the Gulf of Kutch is located in bio-geographical zone, "The coasts of Indo-Malayan Realm" and can be considered as International Union for Conservation of Nature Protected Area Category-I;

And whereas, the flora of Marine National Park mainly consists of mangroves and array of marine algae, including some commercially important species of *Agarophytes* and *Alginophytes and the* coastal line of the Gulf is fringed with luxuriant growth of *Avicennia, Rhizophora* and *Ceriops species* of mangroves and *Salvadora, Ziziypus* and *Prosopis species* are some of the terrestrial species found in that area;

And whereas, the Sanctuary has more than 70 sponge species, 37 species of hard coral and 24 species of soft coral, 150-200 species of fish, 27 species of prawn, 30 species of crab, 200 species of mollusc, 3 species of sea turtle, 3 species of sea snake, 3 species of sea mammal, 94 species of aquatic bird and 78 species of terrestrial bird;

And whereas, many developmental activities including industrial, ports, infrastructural and fishing etc. have been going on in the areas

adjoining the Marine National Park and Marine Sanctuary and thus causing adverse environmental impacts on the Marine National Park and Marine Sanctuary, it is necessary to conserve and protect the area around the protected area of Marine National Park and Marine Sanctuary as Eco-sensitive Zone from ecological and environmental point of view, to protect, propagate or develop wild life therein or its environment;

And whereas, a draft notification under sub-section (1) read with clause (v) and clause (xiv) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) was published in the Gazette of India, Extraordinary, *vide* notification of the Government of India in the Ministry of Environment and Forests number S.O. 353(E), dated the 29th February, 2012, as required under sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986, inviting objections and suggestions from all persons likely to be affected thereby within a period of sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

And whereas, copies of the Gazette containing the said notification were made available to the public on the 29th February, 2012;

And whereas, all objections and suggestions received in response to the draft notification have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) and clause (xiv) of sub – section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) read with sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986, the Central Government

hereby notifies the area up to a length of one kilometre from the coastal boundary towards landward side; an area within 200 metre from the boundary of Marine National Park and Sanctuary towards seaward side and 31 rivers flowing into the Gulf of Kachchh with their length varying from 0 to 5 kilometre and a width of 250 metre from the centre of the river on both sides of river from the boundary of the protected area of Marine National Park and Marine Sanctuary in the State of Gujarat as the Eco-sensitive Zone (herein after called as the Marine National Park and Marine Sanctuary Eco-sensitive Zone) and also in exercise of the powers conferred by sub-section (3) of section 3 of the said Act, the Central Government hereby constitute a State Level Eco-sensitive Monitoring Committee (hereinafter referred to as the SESZMC) and on and from the date of publication this notification, the SESZMC shall monitor the compliance of this notification, in accordance with the following namely:-

1. **Boundaries of Eco-sensitive Zone.-** (1) The Eco-sensitive Zone (hereinafter referred to as the ESZ) towards landward side constitutes an area of about 208.58 square kilometre including 36 villages adjoining Marine National Park and Sanctuary and the boundary of the ESZ from coastal boundary towards landward side extends up to a length of one kilometre which include either whole or part of survey numbers upto this limit of one kilometre.

(2) The ESZ towards seaward side constitutes an area of 105.14 square kilometre and an area within 200 metre from boundary of Marine National Park and Sanctuary towards seaward side has been included in the said Zone.

(3) 31 rivers which flow into the Gulf of Kachchh have been included in the ESZ and the length of the rivers falling in the said Zone varies from 0 to 5 square kilometre and a width of 250 metre from the centre of the river on both sides of river has also been included in the said Zone which constitute a total area of 12.53 square kilometre.

(4) The Eco-sensitive zone is bounded by 22°55'31.33" N latitude and 70°32'57.02" E longitude towards East; 22°28'1.31" N latitude and 69°3'33.77" E longitude towards West; 22°56'14.26" N latitude and 70°25'54.27" E longitude towards North and 22°13'12.35" N latitude and 69°17'43.97" E longitude towards South.

(5) The boundary description of the ESZ of the Marine National Park and Marine Sanctuary is appended with this notification as **Annexure-A.**

(6) The map of the ESZ boundary together with latitude-longitude of the extremes of the boundary is appended with this notification as **Annexure-B.**

(7) The list of villages falling within the ESZ is appended as **Annexure-C** and the same shall be revisited and confirmed by the State Government while preparing the Zonal Master Plan.

2. **Zonal Master Plan for the Marine National Park and Marine Sanctuary Eco-sensitive Zone.-** (1) The State Government shall prepare in consultation with local people a Zonal Master Plan within a period of two years from the date of publication of this notification in the Official Gazette and the same shall be approved by the Ministry of Environment and Forests.

(2) The Zonal Master Plan shall be prepared with due involvement of all concerned Local Self Governments and the State Departments of Environment, Forest, Urban Development, Tourism, Agriculture, Revenue, Public Works Department, Gujarat State Pollution Control Board, Gujarat Coastal Management Authority, Water Resources, Horticulture, Panchayati Raj, Rural Development etc. for integrating environmental and ecological considerations into it.

(3) The Zonal Master plan shall provide for restoration of denuded areas, conservation of existing water bodies, management of catchment areas, watershed management, groundwater management, soil and moisture conservation, needs of local community and such other aspects of the ecology and environment that need attention.

(4) The Zonal Master Plan shall demarcate all the existing village settlements, types and kinds of forests, agricultural areas,, fertile lands, green areas, horticultural areas, orchards, lakes and other water bodies.

(5) The Zonal Master Plan shall regulate the development in the ESZ so as to meet the requirement of local people without affecting the rights and privileges of the bona-fide residents and also ensure eco friendly development for their livelihood security.

(6) The Zonal Master Plan shall be a reference document for the Monitoring Committee for any decision to be taken by them including consideration for relaxation.

(7) (a) Change of land use such as forest, horticulture areas, agriculture, parks and open spaces earmarked for recreational purposes for the commercial or industrial development activities shall not be permitted in the ESZ:

Provided that the conversion of agricultural lands within the ESZ shall be permitted to meet the residential needs of the local residents due to the natural growth of existing local population with the prior approval of the State Government on the recommendation of SESZMC:

Provided further that no change in use of land from tribal uses to non-tribal usages shall be permitted without the prior approval of the State Government.

(8) There shall be no consequential reduction in green area such as forest area, agricultural area, etc.

(9) The Central Government and the State Government shall specify other measures, if it considers necessary, in giving effect to the provisions of this notification.

(10) (a) The tourism activities shall be as per the Tourism Master Plan prepared by the Department of Tourism of the Gujarat State Government;

(b) The Tourism Master Plan shall also form a component of the Zonal Master Plan and shall be based on a detailed carrying capacity study

of the concerned protected area as well as the ESZ, which may be carried out by the State Government.

(c) All new tourism activities, development for tourism or expansion of existing tourism activities shall be permitted only within the parameters of this Tourism Master Plan.

(d) The carrying capacity study shall be carried out based on the existing infrastructure and shall not be based on future projections of any project that requires environmental or forest clearance.

(e) Till the Zonal Master Plan is approved, development for tourism and expansion of existing tourism activities shall be permitted by the Monitoring Committee only after a detailed examination and shall be subject to the guidelines laid down by the State Government and the Central Government in this regard.

3. Activities to be prohibited, regulated or permitted within the Eco-sensitive Zone.- (1) All activities in the Marine National Park and Marine Sanctuary Eco-sensitive Zone shall be governed by the provisions of the Environment (Protection) Act, 1986 (29 of 1986).

(2) The activities in the ESZ are prohibited, regulated or permitted in accordance with **Annexure-D** to this notification.

(3) (a) *No new polluting industries and expansion of existing industries* shall be allowed in the ESZ.

(b) The existing industries such as salt manufacturing units, ship breaking and building units, shipping yards, etc. shall not be allowed to discharge effluents, slurry, etc. into the ESZ and shall take adequate measures to prevent any leakage of brine water or harmful chemicals into the water.

(c) The raw material (crude oil) and finished product carrying vessels from the refineries shall not pollute the ESZ.

(d) No washing release of ballast water or any hydro carbon material shall be permitted in the ESZ.

(4) The structures connected with small agro-based industries, activities related to the needs of the local village economy and processing or storage of local agro-based products shall be allowed subject to the permission to be obtained from the revenue authorities for alienation of land for non-agricultural purposes.

(5) (a) All quarrying and mining activities shall be banned in the ESZ and no fresh mining leases shall be granted.

(b) Collection of shells or any other marine resources in the ESZ shall be prohibited.

(6) Mechanised fishing including fishing by trawlers shall be prohibited.

(7) (a) Strict norms shall be followed in regulating the movement of vehicles in and around the ESZ.

(b) Preventive measures shall be taken during transportation of goods, etc. in order to prevent spraying dust particles on mangroves and other flora and fauna.

(c) The Gujarat Maritime Board and the industrial units using their jetties shall take measures to contain the dust particles from their godowns or consignments.

(d) Preventive measures shall be taken to prevent leakages of fuel from the vehicles and to prevent oil spills in and around the ESZ.

(8) There shall be no felling of trees either on forest, Government, revenue or private land without the prior permission of the State Government in case of forest land and respective district Collector in case of Government, revenue and private land, granted in such manner as may be laid down by the State Government.

(9) The use of plastics, laminates and tetra-packs within the ESZ shall be regulated as per the activities mentioned in this notification.

(10) Any non-forestry activities shall be regulated in accordance with the guidelines issued *vide* letters No. 6-10/2011WL the dated 15th March, 2011 and the 19th December, 2012 by the Ministry of Environment and Forests.

(11) (a) No untreated effluent shall be permitted to be discharged into any water body or water source within the ESZ.

(b) Effluents from all existing industrial or residential areas shall be treated and recycled properly and if possible the treated water may be reused for various purposes.

(c) If discharge of treated or untreated is inevitable, it shall be done in deep sea through long distance leak proof pipe line strictly in

accordance to the provisions of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974).

(12) (a) The discharge of any industrial solid wastes in the ESZ shall be prohibited.

(b) The local authorities shall draw up plans for the segregation of domestic solid wastes into biodegradable and non-biodegradable components.

(c) The biodegradable material shall be recycled preferably through composting or vermiculture and the inorganic material shall be disposed of at environmentally acceptable locations.

(d) No burning or incineration of solid wastes shall be permitted.

(e) The solid waste disposal in the ESZ shall be carried out as per the provisions of the Municipal Solid Waste (Management and Handling) Rules, 2000 issued by the Central Government *vide* notification number S.O. 908(E), dated the 25th September, 2000 and amended from time to time.

(13) (a) The catchment area of all natural springs and streams shall be identified and their conservation plans along with rejuvenation plans of those that have run dry in their natural setting shall be incorporated in the Zonal Master Plan.

(b) Strict guidelines shall be drawn up by the State Government to ban development activities at or near these areas.

4. State Level Eco-sensitive Zone Monitoring Committee.– (1) A State Level Eco-sensitive Zone Monitoring Committee (hereinafter referred to as the SESZMC) shall be constituted by the Central Government under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 comprising of the following Chairman and Members, namely:-

(a) Chief Secretary, Government of Gujarat- Chairman

(b) a representative of the Department of Urban Development, Government of Gujarat – Member;

(c) a representative of the Ports and Transport Department, Government of Gujarat – Member;

(d) a representative of Non-governmental Organizations working in the field of natural conservation (including heritage conservation) to be nominated by the State Government of Gujarat – Member;

(e) the Regional Officer, Gujarat State Pollution Control Board, Gandhi Nagar– Member;

(f) one expert in Ecology from reputed Institution or University of the State of Gujarat - Member;

(g) the District Collector or his representative, Jamnagar – Member;

(h) the Director, Marine National Park and Marine Sanctuary – Member.

(i) Director, Department of Environment, Government of Gujarat– Member Secretary.

(2) The SESZMC shall monitor the compliance of the provisions of this notification.

(3) In case of activities that are covered in the Schedule to the notification of the Government of India in the Ministry of Environment and Forests number S.O. 1533(E), dated the 14th September, 2006 as amended from time to time, and are falling in the ESZ except the prohibited activities as provided under sub-paragraph(2) of paragraph 3 and Annexure-D to this notification, shall be scrutinised by the SESZMC based on the actual site-specific conditions and shall be referred to the Central Government in the

Ministry of Environment and Forests for prior environmental clearances under the provisions of the said notification.

(4) The activities that are not covered in the Schedule of notification of the Government of India in the Ministry of Environment and Forests number S.O. 1533(E), dated the 14th September, 2006 as amended from time to time, and are falling in the ESZ except the prohibited activities as provided under sub-paragraph(2) of paragraph 3 and Annexure-D to this notification, shall be scrutinised by the SESZMC based on the actual site-specific conditions and shall be referred to the concerned regulatory authorities.

(5) The Chairman or the Member Secretary of the SESZMC shall be competent to file complaints under section 19 of the Environment (Protection) Act, 1986 (29 of 1986) against any person who contravenes the provisions of this notification.

(6) The SESZMC may invite representatives or experts from concerned Departments, representatives from Industry Associations or concerned stakeholders to assist in its deliberations depending on the requirements on issue to issue basis.

(7) The SESZMC shall submit the annual action taken report of its activities by the 31st March of every year to the Central Government in the Ministry of Environment and Forests.

(8) The Central Government in the Ministry of Environment and Forests shall give directions, from time to time, to the SESZMC for effective discharge of their functions.

Annexure-A

Boundary description of the Marine National Park and Marine Sanctuary Eco-sensitive Zone

North :- Coastal boundary of village Adatra , village boundary of Adatra, Coastal boundary of village Padli, Coastal boundary of village Hamusar, Coastal boundary of village Shamlasar, Coastal boundary of village Poshitra, village boundary of Poshitra, Coastal boundary of village Khatumba, boundary of village Khatumba, boundary of village Aniary of Dwarka Taluka of Jamnagar District, Tata salt, Coastal boundary of village Pindhara, Coastal boundary of village Mevasa and village boundary of Virpur, Coastal boundary of village Virpur, Coastal boundary of village Mota Ashota of Kalyanpur Taluka of Jamnagar District, Coastal boundary of village Nana Ashota, Coastal boundary of village Zakasiya, Coastal boundary of village Beh, Coastal boundary of Vachalabara area, Coastal boundary of village Kalawad simani, Coastal boundary of village Chudeshwar, Coastal boundary of village Goinj of Khambhaliya Taluka of Jamnagar District, Boundary of village Balachadi towards village Khiri, Coastal boundary of village Balachadi, Coastal boundary of village Hadiyana, Coastal boundary of village Kunnad, Coastal boundary of village Jodiya, Coastal boundary of village Ranjitpar, Coastal boundary of village Jamsar, Coastal boundary of village Manamora, Coastal boundary of village Kothariya, Coastal boundary of village Rampar Padabekar, Coastal boundary of village Bela and village Untbet sampar, boundary of village Zinzuda towards Fadsar and coastal boundary of village Zinzuda of Jodiya Taluka of Jamnagar District

East :- Village boundary of Bodki of Maliya Taluka of Rajkot District, Coastal boundary of village Goinj and village boundary of Salaya of Khambhaliya Taluka of Jamnagar District.

South :- Boundary of village Arambhada towards Adatra village, boundary of village Padli towards Arambhada village, 1 Km. distance from coastal boundary of village Padli and survey numbers 13, 10, 16, 17, 3pt, 23pt, 28 of village Padli, 1 Km. distance from Revenue boundary of village Hamusar and survey numbers 16, 15, 14, 140, 44, 162, 163, 58, 59, 66, road of village Hamusar, 1 Km distance from coastal boundary of village Samlasar and survey numbers 222, 221, 220, 110, 114, 113, 94, 95, 101, 100, 168, 170, 211, 212, 210, 209, 208, 233, 234, 239, 238, 260, 250, 251, 225, 288 pt of village Samlasar, 1 Km. distance from coastal Boundary of village Poshitra and survey numbers 1pt, 412, 419, 420, 430, 431, 482, 479, 478, 498, 501, 517, 516, 6, 7, 14, 36, 62, 63, 64, 65, 60, 52, 53, 40, 47, 453, 451, 447, 130, 131, 132, 133, 134, 135, 152, 154, 167, 164, 237, 235, 243, 242, 222, 216, 215, 214, 213, 212, 250, 249, 254, 251, 252, 280, 282, 283, 284, 285, 324, 323, 321, 320,

319, 336, 337, 338, 301, 302, 303 of village Poshitra, Boundary of village Poshitra towads village Mulvel and survey numbers 210 of village Mulvel, 1 Km. distance of coastal boundary of village Khatumba and survey numbers 39/1, 38, 45, 46, 54, 53, 62, 56, 57, 58, 59pt of village Khatumba, Boundary of village Tupani of village Aniary, Boundary of village Gurgadh of village Tupani and survey numbers 241pt of Dwarka Taluka of Jamnagar District, 1 Km of distance from coastal boundary of village Gurgadh and survey numbers 61pt, 20, 404pt, 70, 28/2, 27, 25, 511, 436, 477, 478, 442, 445, 449, 450, 456, 457, 470, 471, 472, 473, 478, 479, 521, 520, 427, 402, 528, 421, 385, 533, 370, 364, 365, 366 of village Gurgadh, 1 Km. distance from coastal boundary of village Pindhara and survey numbers 111, 112, 198, 90, 89, 82, 81, 80, 399, 420, 394, 71, 424, 68, 41, 40, 44, 422, 45, 46, 48, 49, 24, 336, 405, 339, 43, 4/1, 336pt, 433, 371, 317, 316, Rasto of village Pindhara, 1 Km. distance from coastal boundary of village Mevasa and survey numbers 330pt, 267, 266, 268/2, 270, 274, 424, of village Mevasa, 1 Km. distance from coastal boundary of village Virpur and survey numbers 118/2, 155, 119, 116, 115, 114, 113, 112, 111, 110pt, 59, 183, 56, 53 of village Virpur, 1 Km. distance from coastal boundary of village Mota Ashota and Survey numbers 550, 215, 171, 172, 238pt, 167, 168, 181, 128, 129, 125, 124, 123, 192, 194, 201, 202, 200, 285, 286, 521, 520, 75, 76, 71, 72, 69, 66, 55, 538, 45, 47 of village Mota Ashota of Kalyanpur Taluka of Jamnagar District, 1 Km. distance from coastal boundary and Survey numbers 99, 101, 95, 92, 91, 128 pt, 66, 62/1, 68, 15, 16, 18, 22, 27, 27/2, 28, 50, 48, 47 of village Nana Ashota, 1 Km. distance from coastal boundary of village Zakasiya and Survey numbers 101, 412, 406, 407, 74, 77, 73, 409, 72, river of village Zakasiya, 1 Km distance from coastal boundary of village Beh and survey numbers 91, 89, 82, 81, 83, 73, 72, 67, 56, 58, 49, 50, 30, 27, 22, 20, 19,18, 16, 15, 9, 456, 455, 439, 431, 428, River of village Beh, 1 Km distance from coastal boundary of village Vachlabara and survey numbers 859, 858, 857, 883, 844, 885 ,804, 803, 810, 815, 814, 817, 822, 797, 739, 717, 711, 710, 712, 709, 572, 586, 587, 588, 589, 590, 591, 581, 599, 598, 597, 596, 593, 530, 532, 534, 535, 536, 538, 539, 511, 508, 509, 519, 520, 516, 515, 527, 594, 603, 604, 616, 617, 619, 642, 380, 379, 367, 364, 348, 347, 345, 363, 263, 264, 259, travers number of village Vachlabara, 1 Km distance from coastal boundary of village Kalavad simani and survey numbers 179pt, 3, 7, 8, 161, 160, 158, 152, 149, 128, 132, 124, 125, 121, 91, 93, 182 of village Kalavad simani, 1 Km distance from coastal boundary of village Chudeshwar and survey numbers 249, 251, 252, 255, 257, 258, 260, 261, 262, 265, 266, 320, 325, 237, 129, 102, 72, 71, 70, 75, 76, 87, 86 of village Chudeshwar, 1 Km distance from coastal boundary of village Goinj and survey numbers 267, 280, 279, 278, 277, 276, 275, 274, 304, 303, 302, 301, 299, 225, 211, 212, 197, 196, 185, 123, 179, Rasto of village Goinj of Khambhaliya Taluka of Jamnagar District, Boundary of village Sachana towards Khiri village, 1 Km. distance from coastal boundary of village Balachadi and survey numbers 8, 86, 99, 116, 76,

118, 5, 140, 139, 138, 19, 20, 21, 119, 24, 25, 59, 58, 56 of village Balachadi, 1 Km. distance from coastal boundary of village Hadiyana and survey numbers 629pt, 628pt, 653pt of village Hadiyana, 1 Km. distance from coastal boundary of village Kunnad and survey numbers 315 pt, 326, 329, 330, 332, 333, 334, Rasto of village Kunnad, 1 Km. distance from coastal boundary of village Jodiya and survey numbers 411, 393, 391pt, 390, 388, river, 339, 349, 325, 328, 310, 305, 302, 299pt, 298pt of village Jodiya, 1 Km. distance from coastal boundary of village Ranjitpar and survey numbers 410pt of village Ranjitpar, 1 Km. distance from coastal boundary of village Jamsar and survey numbers 119pt, 121, 70, 71, 72, 74, 73, 94, 97, 98, 103, 102 of village Jamsar, 1 Km. distance from coastal boundary of village Manamora and survey numbers 299, 301, 302, 303, 304, 273, 274, 272, 271, 252, 367pt, 242, 190, 368, 79, 63, 139, 62, 159, 158, 154, 156, 142, 141, 130 of village Manomora, 1 Km. distance from coastal boundary of village Kothari and survey numbers 160, 146, 144, 133, 132, 117, 116, 119, 108, 107, 66, 67, 69, 74 of village Kothari, 1 Km. distance from coastal boundary of village Rampar padabekar and survey numbers 306, 305, 310, 297, 312, 313, 316, 119, 120, 121, 130, 131, 136, 133, 134, 163, 172, 171, 170, 169, 179, 183, 185, 184 of village Rampar padabekar, 1 Km. distance from coastal boundary of village Bela and survey numbers 192, 191, 175, 157, 291, 312, 293 of village Bela, 1 Km. distance from coastal boundary of village Untbet sampar and survey numbers 232pt, 208, 175, 170, 151, 150, 146, 143, 140 of village Untbet sampar, 1 Km. distance from coastal boundary of village Fadsar and survey numbers 401/1pt, 1 Km. distance from coastal boundary of village Zinzuda and survey numbers 129/1, 3, 83, 37, 9, 39, 30, 78, 75, 70 of village Zinzuda of Jodiya Taluka of Jamnagar District.

West :- Coastal boundary of village Khiri and Balachadi of Jodiya Taluka of Jamnagar District and village boundary of Adatra and Arambhada of Dwarka Taluka of Jamnagar District.

Boundary description of rivers falling in the Marine National Park and Marine Sanctuary Eco-sensitive Zone

North :- Coastal boundary of village Zinzuda and Untbet sampar of Zinzuda river, Coastal boundary of village Ranjitpar, Jamsar and Manamora of Aji river, Coastal boundary of village Jodiya and Kunnad of Und river, Coastal boundary of village Hadiyana of Kankavati river, Coastal boundary of village Sachana and Khiri of Sachana river of Jodiya Taluka of Jamnagar District, Coastal boundary of village Jambuda of Jambuda river, Coastal boundary of village Dhunvav of Dhunvav river, Coastal boundary of village Navanagna and Junanagna of Nagna river, Coastal boundary of village Sarmat of Sarmat river, Coastal boundary of village Bed of Sasoi river, Coastal boundary of village Nanikhavadi of Khavadi river, Coastal boundary of village Gagwa of Gagwa river of

Jamnagar Taluka of Jamnagar District, Coastal boundary of village Jogvad of Jogvad river, Coastal boundary of village Zhakhar of Zhakhar river of Lalpur Taluka of Jamnagar District, Coastal boundary of village Bharana of Bharana river, Coastal boundary of village Mandha of Mandha river, Coastal boundary of village Mota mandha of Sinhan river, Coastal boundary of village Kothavisotri of Ghi river, Coastal boundary of village Goinj of Goinj river, Coastal boundary of village Vachalabar of Bara river, Coastal boundary of village Beh of Beh river, Coastal boundary of village Beh and Zakasiya of Zakasiya river, Coastal boundary of village Nana ashota river of Khambhaliya Taluka of Jamnagar District, Coastal boundary of village Mota ashota of Mota ashota river, Coastal boundary of village Pindhara of Rani river of Kalyanpur Taluka of Jamnagar District, Coastal boundary of village Shamlasar of Shamlasar river of Dwarka Taluka of Jamnagar District.

East :- Village boundary of Zinzuda and Fadsar of Zinzuda river, Village boundary of Manamora, Jamsar, Ranjitpar of Aji river, Village boundary of Jodiya of Und river, Village boundary of Hadiyana of Kankavati river, Village boundary of Khiri of Sachana river of Jodiya Taluka of Jamnagar District, Village boundary of Jambuda of Jambuda river, Village boundary of Dhunvav of Dhunvav river, Village boundary of Navanagna and Vibhapar of Nagna river, Village boundary of Kharaberaja and Gordhanpar of Sarmat river, Village boundary of Sarmat and Vasai of Sasoi river, Village boundary of Khavdi of Khavdi river, Village boundary of Gagwa of Gagwa river of Jamnagar Taluka of Jamnagar District, Village boundary of Jogvad of Jogvad river, Village boundary of Zhankhar of Zhankhar river of Lalpur Taluka of Jamnagar District, Village boundary of Bharana of Bharana river, Village boundary of Mota mandha and Timbadi of Mandha river, Village boundary of Nana mandha of Sinhan river, Village boundary of Kothavisotri, Kabarvisotri, Sodasala of Ghi river, Village boundary of Goin of Goinj river, Village boundary of Vachlabara of Bara river, Village boundary of Vachlabara of Beh river, Village boundary of Beh of Zakasiya river, Village boundary of Nana ashota river of Khambhaliya Taluka of Jamnagar District, Village boundary of Nana ashota of Mota ashota river, Village boundary of Mevasa of Rani river of Kalyanpur Taluka of Jamnagar District, Village boundary of Poshitra and Shamlasar of Shamlasar river of Dwarka Taluka of Jamnagar District.

South :- Village boundary of Fadsar of Zinzuda river, Village boundary of Manamora, Jamsar and Ranjitpar of Aji river, Village boundary of Jodiya of Und river, Village boundary of Hadiyana of Kankavati river, Village boundary of Khiri of Sachana river of Jodiya Taluka of Jamnagar District, Village boundary of Jambuda of Jambuda river, Village boundary of Dhunvav of Dhunvav river, Village boundary of Vibhapar and Nagna of Nagna river, Village boundary of Sarmat of Sarmat river, Village boundary of Bed of Sasoi river, Village boundary of Khavadi of Khavadi river, Village boundary of Gagwa of Gagwa river of Jamnagar Taluka of Jamnagar District, Village boundary of Jogvad of Jogvad river, Village boundary of

Zhankhar of Zhankhar river of Lalpur Taluka of Jamnagar District, Village boundary of Bharana of Bharana river, Village boundary of Mandha of Mandha river, Village boundary of Mandha of Sinhan river, Village boundary of Kothavisotri and Kabarvisotri of Khiri river, Village boundary of Goinj of Goinj river, Village boundary of Vachalabara of Bara river, Village boundary of Beh of Beh river, Village boundary of Beh of Zakasiya river, Village boundary of Nana ashota of Nana Ashota river of Khambhaliya of Jamnagar District, Village boundary of Mota ashota of Mota Asota river, Village boundary of Mevasa and Pindhara of Rani river of Kalyanpur Taluka of Jamnagar District, Village boundary of Shamlasar of Shamlasar river of Dwarka Taluka of Jamnagar District.

West :- Village boundary of Untbet sampar and Zinjuda of Zinjuda river, Village boundary of Manamora, Jamsar and Ranjitpar of Aji river, Village boundary of Kunnad of Und river, Village boundary of Hadiyana of Kankavati river, Village boundary of Khiri and Sachana of Sachana river of Jodiya Taluka of Jamnagar District, Village boundary of Jambuda of Jambuda river, Village boundary of Dhunvav of Dhunvav river, Village boundary of Nagna of Nagna river, Village boundary of Sarmat of Sarmat river, Village boundary of Bed of Sasoi river, Village boundary of Khavadi of Khavadi river, Village boundary of Gagwa of Gagwa river of Jamnagar Taluka of Jamnagar District, Village boundary of Jogvad of Jogvad river, Village boundary of Zhankhar of Zhankar river of Lalpur Taluka of Jamnagar District, Village boundary of Bharana of Bharana river, Village boundary of Mandha of Mandha river, Village boundary of Mota mandha of Sinhan river, Village boundary of Kothavisotri and Kabarvisotri of Ghi river, Village boundary of Goinj of Goinj river, Village boundary of Vachalabara of Bara river, Village boundary of Beh of Beh river, Village boundary of Beh and Zakashiya of Zakasiya river, Village boundary of Nana asota of Nana Ashota river of Khambhaliya Taluka of Jamnagar District, Village boundary of Mota ashota of Mota ashota river, Village boundary of Pindhara of Rani river of Kalyanpur Taluka of Jamnagar District, Village boundary of Shamlasar of Shamlasar river of Dwarka Taluka of Jamnagar District.

Boundary description of around 200 metre towards the sea of the Marine National Park and Marine Sanctuary Eco-sensitive Zone

North :- Gulf of Kachchh towards Zanzarawadi, Gulf of Kachchh towards Ajad tapu, Gulf of Kachchh towards Ashota ni nar, Gulf of Kachchh towards Babudhoro, Gulf of Kachchh towards Barani nar, Gulf of Kachchh towards Berajani nar, Gulf of Kachchh towards Bhad, Gulf of Kachchh towards Bhaidar tapu, Gulf of Kachchh towards Bhalori, Gulf of Kachchh towards Chank tapu, Gulf of Kachchh towards Chusda, Gulf of Kachchh towards Bet sankhodwar, Gulf of Kachchh towards coral area north west Chank reef, Gulf of Kachchh towards Divdi Dhabdhaba, Gulf of Kachchh towards Coral little Bay Sikka, Gulf of Kachchh towards Coral near

Mithapur, Gulf of Kachchh towards Coral near Narara reef, Gulf of Kachchh towards Coral near Okha, Gulf of Kachchh towards coral of Chandri reef, Gulf of Kachchh towards coral of west of Kalubhar, Gulf of Kachchh towards coastal area of Okha, Gulf of Kachchh towards Dhani tapu, Gulf of Kachchh towards Dhoranu jungle, Gulf of Kachchh towards Didika, Mundeka tapu, Gulf of Kachchh towards Gadnhio kado tapu, Gulf of Kachchh towards Jindra tapu, Gulf of Kachchh towards Kadiyari, Gulf of Kachchh towards Kalavad ni nar, Gulf of Kachchh towards Kalubhar tapu, Gulf of Kachchh towards Kharara ni nar, Gulf of Kachchh towards Lafa marodi and Man marodi, Gulf of Kachchh towards Morzangi, Gulf of Kachchh towards Moshido, Gulf of Kachchh towards Moto kharo, Gulf of Kachchh towards Nagarnar nu jungle, Gulf of Kachchh towards Narara jungle, Gulf of Kachchh towards Navinar nu jungle, Gulf of Kachchh towards Noru tapu, Gulf of Kachchh towards Okhari, Gulf of Kachchh towards Pagar reef, Gulf of Kachchh towards Panero tapu, Gulf of Kachchh towards Pirotan tapu, Gulf of Kachchh towards Rai bet, Gulf of Kachchh towards Ravalpir jungle, Gulf of Kachchh towards Ribdi, Gulf of Kachchh towards Rozi bet, Gulf of Kachchh towards Rozinar jungle, Gulf of Kachchh towards Rozinar no val, Gulf of Kachchh towards Sikotari titar dhoro, Gulf of Kachchh towards Sui nu jungle, Gulf of Kachchh towards Untado, Gulf of Kachchh towards Vadinar, Gulf of Kachchh towards West side Okhari.

East :- Marine Sanctuary towards Zanzarawadi, Gulf of Kachchh towards Ajad tapu, Gulf of Kachchh towards Ashota ni nar, Gulf of Kachchh towards Babudhoro, Marine Sanctuary towards Barani nar, Marine Sanctuary towards Berajani nar, Marine National Park towards Bhad, Gulf of Kachchh towards Bhaidar tapu, Marine National Park towards Bhalori and Gulf of Kachchh, Gulf of Kachchh towards Chank tapu, Gulf of Kachchh towards Chusda, Gulf of Kachchh towards Bet sankhodwar, Marine National Park towards coral area north west Chank reef, Gulf of Kachchh towards Divdi Dhabdhaba, Gulf of Kachchh towards Coral little Bay Sikka, Gulf of Kachchh towards Coral near Mithapur, Marine National Park towards Coral near Narara reef, Gulf of Kachchh towards Coral near Okha, Gulf of Kachchh towards coral of Chandri reef, Marine National Park of coral towards west of Kalubhar, Gulf of Kachchh towards coastal area Okha, Gulf of Kachchh towards Dhani tapu, Gulf of Kachchh towards Dhoranu jungle, Gulf of Kachchh towards Didika, Mundeka tapu, Gulf of Kachchh towards Gadnhio kado tapu, Marine National Park towards Jindra tapu, Gulf of Kachchh towards Kadiyari, Marine Sanctuary towards Kalavad ni nar, Gulf of Kachchh towards Kalubhar tapu, Gulf of Kachchh towards Kharara ni nar, Gulf of Kachchh towards Lafa marodi and Man marodi, Marine National Park towards Morzangi, Gulf of Kachchh towards Moshido, Gulf of Kachchh towards Moto kharo, Gulf of Kachchh towards Nagarnar nu jungle, Gulf of Kachchh towards Narara jungle, Gulf of Kachchh towards Navinar nu jungle, Gulf of Kachchh towards Noru tapu, Gulf of Kachchh towards Okhari, Gulf of Kachchh towards Pagar reef, Gulf of Kachchh towards Panero tapu, Gulf of Kachchh towards Pirotan tapu,

Gulf of Kachchh towards Rai bet, Gulf of Kachchh towards Ravalpir jungle, Gulf of Kachchh towards Ribdi, Marine Sanctuary towards Rozi bet, Gulf of Kachchh towards Rozinar jungle, Gulf of Kachchh towards Rozinar no val, Gulf of Kachchh towards Sikotari titar dhoro, Marine Sanctuary towards Sui nu jungle, Gulf of Kachchh towards Untado, Gulf of Kachchh towards Vadinar, Gulf of Kachchh towards West side Okhari.

South :- Marine Sanctuary towards Zanzarawadi, Gulf of Kachchh towards Ajad tapu, Marine Sanctuary towards Ashota ni nar, Marine Sanctuary towards Babudhoro, Marine Sanctuary towards Barani nar, Marine Sanctuary towards Berajani nar, Marine National Park towards Bhad, Sanctuary and National Park and Gulf of Kachchh towards Bhaidar tapu, Gulf of Kachchh towards Bhalori, Gulf of Kachchh towards Chank tapu, Gulf of Kachchh towards Chusda, Gulf of Kachchh towards Bet sankhodwar, Gulf of Kachchh towards coral area north west Chank reef, Gulf of Kachchh towards Divdi Dhabdhaba, Marine National Park towards Coral little Bay Sikka, Gulf of Kachchh towards Coral near Mithapur, Marine National Park towards Coral near Narara reef, Gulf of Kachchh towards Coral near Okha, Gulf of Kachchh towards coral of Chandri reef, Marine National Park towards coral of west of Kalubhar, Gulf of Kachchh towards coastal area of Okha, Gulf of Kachchh towards Dhani tapu, Marine Sanctuary towards Dhoranu jungle, Gulf of Kachchh towards Didika, Mundeka tapu, Gulf of Kachchh towards Gandhio kado tapu, Marine National Park towards Jindra tapu, Marine Sanctuary towards Kadiyari, Marine Sanctuary towards Kalavad ni nar, Gulf of Kachchh towards Kalubhar tapu, Gulf of Kachchh towards Kharara ni nar, Gulf of Kachchh towards Lafa marodi and Man marodi, Marine National Park towards Morzangi, Marine National Park towards Moshido, Gulf of Kachchh and Marine sanctuary towards Moto kharo, Marine sanctuary towards Nagarnar nu jungle, Gulf of Kachchh towards Narara jungle, Marine Sanctuary towards Navinar nu jungle, Gulf of Kachchh towards Noru tapu, Marine sanctuary and National Park and Gulf of Kachchh towards Okhari, Gulf of Kachchh towards Pagar reef, Gulf of Kachchh towards Panero tapu, Marine National Park and Sanctuary towards Pirotan tapu, Marine National Park and sanctuary towards Rai bet, Marine Sanctuary and Gulf of Kachchh towards Ravalpir jungle, Marine Sanctuary towards Ribdi, Marine Sanctuary towards Rozi bet, Marine Sanctuary towards Rozinar jungle, Marine Sanctuary towards Rozinar no val, Marine Sanctuary towards Sikotari titar dhoro, Marine sanctuary and Gulf of Kachchh towards f Sui nu jungle, Marine Sanctuary towards Untado, Marine Sanctuary towards Vadinar, Marine Sanctuary towards West side of Okhari.

West :- Gulf of Kachchh towards Zanzarawadi, Gulf of Kachchh towards Ajad tapu, Gulf of Kachchh and Marine Sanctuary towards Ashota ni nar, Gulf of Kachchh towards Babudhoro, Gulf of Kachchh towards Barani nar, Marine National Park towards Berajani nar, Gulf of Kachchh towards Bhad, Gulf of Kachchh towards Bhaidar tapu, Gulf of Kachchh towards Bhalori, Gulf of Kachchh towards Chank tapu, Gulf of Kachchh towards Chusda,

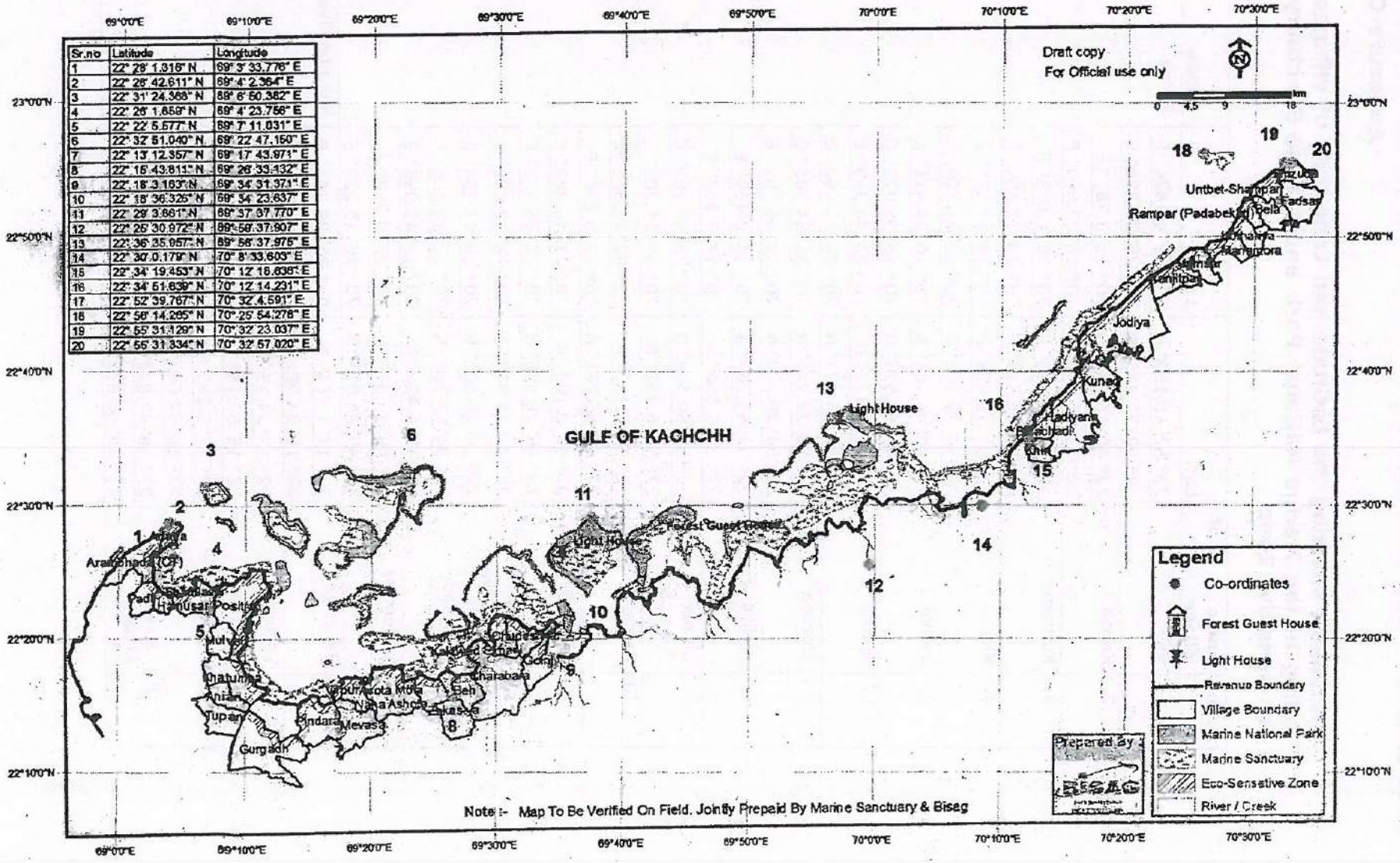
Gulf of Kachchh towards Bet sankhodwar, Gulf of Kachchh towards coral area north west Chank reef, Gulf of Kachchh towards Divdi Dhabdhaba, Marine National Park and Sanctuary towards Coral little Bay Sikka, Gulf of Kachchh towards Coral near Mithapur, Gulf of Kachchh towards Coral near Narara reef, Gulf of Kachchh towards Coral near Okha, Gulf of Kachchh towards coral of Chandri reef, Gulf of Kachchh towards coral of west of Kalubhar, Marine Sanctuary towards coastal area of Okha, Gulf of Kachchh towards Dhani tapu, Gulf of Kachchh towards Dhoranu jungle, Gulf of Kachchh towards Didika, Mundeka tapu, Gulf of Kachchh towards Gandhio kado tapu, Marine National Park and Sanctuary towards Jindra tapu, Gulf of Kachchh towards Kadiyari, Marine National Park towards Kalavad ni nar, Gulf of Kachchh towards Kalubhar tapu, Gulf of Kachchh towards Kharara ni nar, Gulf of Kachchh towards Lafa marodi and Man marodi, Marine Sanctuary towards Morzangi, Marine National Park towards Moshido, Gulf of Kachchh towards Moto kharo, Gulf of Kachchh and Marine Sanctuary towards Nagarnar nu jungle, Gulf of Kachchh towards Narara jungle, Gulf of Kachchh towards Navinar nu jungle, Gulf of Kachchh towards Noru tapu, Gulf of Kachchh towards Okhari, Gulf of Kachchh towards Pagar reef, Gulf of Kachchh towards Panero tapu, Gulf of Kachhh towards Pirotan tapu, Gulf of Kachchh towards Rai bet, Gulf of Kachchh towards Ravalpir jungle, Gulf of Kachchh towards Ribdi, Marine Sanctuary towards Rozi bet, Marine Sanctuary towards Rozinar jungle, Marine Sanctuary towards Rozinar no val, Gulf of Kachchh towards Sikotari titar dhoro, Gulf of Kachchh towards Sui nu jungle, Gulf of Kachchh towards Untado, Gulf of Kachchh towards Vadinar, Marine Sanctuary towards West side of Okhari.

Total area of the Marine National Park and Marine Sanctuary Eco-sensitive Zone Jamnagar

Name of National Park /Sanctuary	Description of the Eco-sensitive zone	Area in hectare
Marine Sanctuary and Marine National Park	(1) 1 Km. distance towards landward side	20858.18
	(2) Rivers falling in Eco-sensitive zone	1253.84
	(3) 200 mt. towards sea	10514.00
	Total :-	**32626.02**

Annexure-B

Map Showing the Marine National Park and Marine Sanctuary Eco-sensitive Zone, District Jamnagar, Gujarat


69°00'E
69°10'E
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69°40'E
69°50'E
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km
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GULF OF KACHCHH
Light House
Forest Guest House
Jodiya
Kuneri
Untbet-Shampar
Rampar (Padabeka)
Bela
Adsar
Mamajora
Jamnagar
Khijadiya
Bedi
Sikka
Vibhapar
Jhakhar
Khambhalia
Dwarka
Okha
Positra
Mutva
Chhatrasa
Kharaba
Sikka
Jodiya
Kuneri
Bedi
Vibhapar
Khijadiya
Jamnagar
Mamajora
Bela
Adsar
Untbet-Shampar
Rampar (Padabeka)

Annexure-C

Statement showing the Latitude and Longitude of villages falling in the Marine National Park and Marine Sanctuary Eco-sensitive Zone

S.No.	Name of village	Lat.	Long.	Taluka
1.	Bela	22° 52' 48.180" N	70° 29' 40.874" E	Jodiya
		22° 52' 21.306" N	70° 29' 59.395" E	
2.	Kunad	22° 40' 15.651" N	70° 16' 8.782" E	
		22° 39' 26.782" N	70° 16' 27.660" E	
3.	Kothariya	22° 50' 30.953" N	70° 28' 1.868" E	
		22° 50' 15.318" N	70° 28' 32.659" E	
4.	Khiri	22° 34' 18.958" N	70° 12' 17.735" E	
		22° 34' 19.362" N	70° 12' 21.109" E	
5.	Jodiya	22° 40' 44.181" N	70° 16' 24.411" E	
		22° 40' 58.523" N	70° 16' 55.072" E	
6.	Jamsar	22° 48' 9.412" N	70° 23' 46.369" E	
		22° 47' 55.433" N	70° 24' 20.463" E	
7.	Zinzuda	22° 54' 27.746" N	70° 31' 54.708" E	
		22° 54' 20.709" N	70° 31' 49.881" E	
8.	Hadiyana	22° 37' 53.267" N	70° 14' 0.469" E	
		22° 37' 5.550" N	70° 14' 3.812" E	
9.	Untbet-Shampar	22° 52' 50.163" N	70° 29' 40.289" E	
		22° 53' 6.062" N	70° 30' 11.203" E	
10.	Fadsar	22° 54' 7.106" N	70° 32' 22.571" E	
		22° 53' 56.761" N	70° 32' 5.278" E	
11.	Ranjitpar	22° 47' 0.189" N	70° 21' 46.882" E	
		22° 46' 26.405" N	70° 21' 55.357" E	
12.	Rampar (Padabekad)	22° 51' 36.903" N	70° 28' 42.099" E	
		22° 51' 26.602" N	70° 29' 17.284" E	
13.	Balachadi	22° 34' 53.328" N	70° 12' 16.106" E	
		22° 35' 1.420" N	70° 12' 49.998" E	
14.	Manamora	22° 49' 7.639" N	70° 26' 0.252" E	
		22° 48' 44.815" N	70° 26' 25.229" E	
15.	Zakasiya	22° 17' 1.764" N	69° 25' 29.763" E	Khambhaliya
		22° 16' 34.991" N	69° 25' 49.561" E	
16.	Vachlabara	22° 17' 24.155" N	69° 28' 16.164" E	
		22° 16' 53.188" N	69° 28' 26.708" E	
17.	Nana Ashota	22° 17' 5.285" N	69° 23' 34.608" E	
		22° 16' 32.642" N	69° 23' 39.232" E	
18.	Kalawad Simani	22° 18' 47.024" N	69° 29' 42.854" E	
		22° 18' 46.835" N	69° 30' 17.975" E	

Annexure-D
[See paragraph 3]

Activities to be prohibited, regulated or permitted within the Marine National Park and Marine Sanctuary Eco-sensitive Zone.

S.No.	Activity	Prohibited	Regulated	Promoted	remarks
1.	Commercial Mining	Yes	-	-	Regulation will not prohibit the digging of earth for construction or repair of houses and for manufacture of country tiles or bricks for housing for personal consumption.
2.	Felling of trees	-	Yes	-	With permission from appropriate authority.
3.	Setting of saw mills	Yes	-	-	-
4.	Setting of industries causing pollution (Water, Air, Soil, Noise, etc)	Yes	-	-	-
5.	Establishment of hotels and resorts	-	Yes	-	As per approved Master Plan, which takes care of habitats allowing no restriction on movement of wild animals.

19.	Goinj	22° 20' 34.158" N	69° 33' 37.374" E	
		22° 19' 43.928" N	69° 33' 26.401" E	
20.	Chudeshvar	22° 21' 42.189" N	69° 30' 42.327" E	
		22° 21' 6.471" N	69° 30' 46.625" E	
21.	Beh	22° 17' 14.652" N	69° 26' 52.569" E	
		22° 16' 48.060" N	69° 26' 32.524" E	
22.	Virpur	22° 15' 23.371" N	69° 17' 7.512" E	Kalyanpur
		22° 15' 40.335" N	69° 17' 38.032" E	
23.	Pindara	22° 12' 56.137" N	69° 14' 12.318" E	
		22° 12' 28.240" N	69° 14' 30.217" E	
24.	Mevasa	22° 15' 18.957" N	69° 17' 5.266" E	
		22° 14' 49.006" N	69° 17' 19.780" E	
25.	Gurgadh	22° 14' 49.927" N	69° 10' 16.714" E	
		22° 14' 20.869" N	69° 10' 0.959" E	
26.	Asota Mota	22° 16' 42.632" N	69° 19' 29.087" E	
		22° 16' 11.474" N	69° 19' 47.447" E	
27.	Tupani	22° 14' 39.852" N	69° 10' 11.326" E	Dwarka
		22° 14' 45.784" N	69° 9' 42.106" E	
28.	Shamlasar	22° 23' 10.958" N	69° 4' 16.644" E	
		22° 22' 42.487" N	69° 4' 16.788" E	
29.	Positra	22° 23' 46.487" N	69° 7' 47.985" E	
		22° 23' 5.969" N	69° 7' 42.673" E	
30.	Padli	22° 24' 14.913" N	69° 2' 48.458" E	
		22° 24' 15.942" N	69° 2' 12.303" E	
31.	Mulvel	22° 19' 14.799" N	69° 8' 55.325" E	
		22° 18' 47.023" N	69° 8' 49.611" E	
32.	Khatumba	22° 18' 24.444" N	69° 9' 30.755" E	
		22° 18' 31.769" N	69° 8' 54.176" E	
33.	Hamusar	22° 23' 55.055" N	69° 3' 9.094" E	
		22° 23' 14.977" N	69° 2' 50.736" E	
34.	Arambhada (CT)	22° 26' 34.203" N	69° 2' 46.176" E	
		22° 27' 20.610" N	69° 3' 18.984" E	
35.	Aniari	22° 15' 8.998" N	69° 10' 25.643" E	
		22° 15' 27.680" N	69° 9' 57.101" E	
36.	Adatra	22° 26' 13.755" N	69° 3' 1.412" E	
		22° 26' 35.478" N	69° 3' 20.710" E	

6.	Commercial use of firewood	Yes	-	-	For hotels and other business related establishment
7.	Drastic change of agriculture systems	-	Yes	-	-
8.	Commercial use of natural water resources including ground water harvesting	-	Yes	-	As per approved Master Plan, which takes care of habitats allowing no restriction on movement of wild animals.
9.	Establishment of major hydroelectric projects	Yes	-	-	-
10.	Erection of electrical cables	-	Yes	-	Promote underground cabling.
11.	Ongoing agriculture and horticulture practices by local Communities along with aquaculture and fisheries	-	-	Yes	Excessive expansion of some of these activities and excessive exploitation of the marine resources shall be regulated as per the Master Plan.
12.	Rain Water harvesting	-	-	Yes	Shall be promoted.
13.	Fencing of premises of hotels and lodges	-	Yes	-	-
14.	Organic farming	-	-	Yes	Shall be promoted.
15.	Use of	-	Yes	-	-

	polythene bags by shopkeepers				
16.	Use of renewable energy sources	-	-	Yes	Shall be promoted.
17.	Widening of roads	-	Yes	-	This shall be done with proper Environment Impart Assessment and mitigation measures.
18.	Movement of vehicular traffic at night	-	Yes	-	For commercial purpose.
19.	Introduction of exotic species	-	Yes	-	-
20.	Use or production of any hazardous substances	Yes	-	-	-
21.	Undertaking activities related to tourism like over-flying the National Park area by any aircraft, hot-air balloons and activities related to coastal tourism	Yes	-	-	-
22.	Protection of hill slopes and river banks and coastal areas	-	Yes	-	As per the Master Plan
23.	Discharge of untreated effluents and	Yes	-	-	-

	solid waste in natural water bodies or terrestrial area				
24.	Discharge of treated effluents in natural water bodies or terrestrial area		Yes	-	Recycling of treated effluent be encouraged and for disposal of sludge or solid waste, the existing regulations shall be followed.
25.	Air and vehicular pollution	-	Yes	-	-
26.	Sign boards and hoardings	-	Yes	-	-
27.	Adoption of green technology for all activities	-	-	Yes	Shall be promoted.
28.	Mechanised Fishing including fishing by trawlers	Yes	-	-	-
29.	Traditional fishing	-	-	Yes	Permitted with restrictions and laws prevailing in the State.
30.	Salt work activities	-	Yes	-	-
31.	Sea water withdrawal	-	Yes	-	It shall be allowed to the existing Industries as per the law in force.

32.	Erection of conveying systems and pipelines(oil and gas, seawater intake, treated effluent) on terrestrial or sub-surface	-	Yes	-	Activities like erection of conveying systems and pipelines(oil and gas, seawater intake, treated effluent) on terrestrial or sub-surface shall be included under the regulated activities as all these infrastructure or facilities already exists in the proposed ESZ.

[F. No. 25/2/2012-ESZ/RE]

DR. G. V. SUBRAHMANYAM, Scientist 'G'

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and Published by the Controller of Publications, Delhi-110054.

"Annexure 3"

મુખ્ય વન સંરક્ષકશ્રીની કચેરી,
મરીન નેશનલ પાર્ક, "વન સંકુલ", નાગનાથ ગેટપાસે, ગંજીવાડો,
જામનગર ૩૬૧૦૦૮. Tel No.(0288) 2679357 Fax No.2770161
E-mail:- mnpforest@gmail.com / mnpforest@yahoo.com

જાવક નં.:-૬/જમન/ટે.૭/ 220 /૨૦૨૦-૨૧ તા:-૪/૧૨/૨૦૨૦.

પ્રતિ,
અધિકૃત અધિકારીશ્રી,
નયારા એનર્જી લીમીટેડ,
પો.બો.નં.૨૪, ખંભાળિયા.

વિષય:- Regarding Environment Clearance application of Nayara Energy Limited for Expansion of Refinery from 20 MMTPA to 46 MMTPA and Petro-Chemical Complex at Vadinar.

સંદર્ભ:- આપશ્રીના પત્રાંક:-Nayara Energy/ENV/Forest/MNP/2020/999 તા:-૧૧/૧૨/૨૦૨૦

જય ભારત સહ ઉપરોક્ત વિષય અન્વયે જણાવવાનું કે સંદર્ભપત્રથી આપશ્રી દ્વારા આપના રીફાઇનરી અને પેટ્રોકેમિકલ કોમ્પ્લેક્ષ અને COT વિસ્તારની હદ દર્શાવતો નકશો મોકલી આપેલ છે. આ નકશા મુજબ આપના રીફાઇનરી અને પેટ્રોકેમિકલ કોમ્પ્લેક્ષ અને COT વિસ્તારથી નજીકના ઇકો સેન્સીટીવ ઝોનનું અંતર દર્શાવવા જણાવેલ છે.

સદર બાબતે જણાવવાનું કે આ વિસ્તારમાં મરીન નેશનલ પાર્ક અને સેન્ચુરી વિસ્તારથી જમીન તરફનો ઇકો સેન્સીટીવ ઝોન જાહેર થયેલ નથી. મરીન નેશનલ પાર્ક અને સેન્ચુરી વિસ્તારથી દરિયા તરફના વિસ્તારમાં તથા મરીન નેશનલ પાર્ક અને સેન્ચુરીમાં જોડાતી નદીઓના વિસ્તારમાં ઇકો સેન્સીટીવ ઝોન જાહેર થયેલ છે જે ધ્યાને લઇ અન્વયે નીચે મુજબની વિગતો છે.

- સંદર્ભપત્રથી આપશ્રી દ્વારા અત્રેની કચેરીએ મોકલી આપેલ નકશામાં દર્શાવેલ જી.પી.એસ. A થી H મુજબ આપના રીફાઇનરી અને પેટ્રોકેમિકલ કોમ્પ્લેક્ષથી સૌથી નજીક અંદાજે ૧૨૦.૦૦ મીટર દુર નદીઓનો ઇકો સેન્સીટીવ ઝોન આવેલ છે તથા મરીન નેશનલ પાર્ક અને સેન્ચુરીનો દરિયા તરફનો ઇકો સેન્સીટીવ ઝોન અંદાજે ૭.૮૦ કિમી દુર આવેલ છે.
- સંદર્ભપત્રથી આપશ્રી દ્વારા અત્રેની કચેરીએ મોકલી આપેલ નકશામાં દર્શાવેલ જી.પી.એસ. I થી N મુજબ આપના COT વિસ્તારથી સૌથી નજીક અંદાજે ૫૩૦.૦૦ મીટર દુર નદીઓનો ઇકો સેન્સીટીવ ઝોન આવેલ છે તથા મરીન નેશનલ પાર્ક અને સેન્ચુરીનો દરિયા તરફના ઇકો સેન્સીટીવ ઝોનથી અંદાજે ૩.૨૦. કિમી દુર આવેલ છે.

જે મુજબ સંદર્ભપત્રથી અત્રેને મોકલી આપેલ નકશામાં દર્શાવ્યા મુજબનો આપનો રીફાઇનરી અને પેટ્રોકેમિકલ કોમ્પ્લેક્ષ અને COT વિસ્તાર મરીન નેશનલ પાર્ક અને સેન્ચુરીના જાહેર થયેલા ઇકો સેન્સીટીવ ઝોન વિસ્તારથી બહાર આવેલ છે.

નાયબ વન સંરક્ષક,
મરીન નેશનલ પાર્ક,જામનગર.

True Copy
Swayam

Ref no.: k/JMN/T-7/220//2020-21

Date: 14/12/2020

To,

The Authorised Signatory,

Nayara Energy Limited,

P. O. Box No. 24, Khambhalia

Subject : Regarding Environment Clearance application of Nayara Energy Limited for Expansion of refinery from 20 to 46 MMTPA and Petro-Chemical Complex at Vadinar.

Reference : Your letter No. Nayara Energy/ENV/Forest/MNP/2020/999, dated 11/12/2020

We would like to state under the above subject that you have sent a map showing boundary of refinery and petrochemical complex and COT area through above referred letter. According to this map, you have asked to show the distance of nearby Eco Sensitive Zone from your refinery and petrochemical complex and COT area.

It is pertinent to mention here that area has not been declared as Eco Sensitive Zone from Marine National Park and Sanctuary area towards landward side. Eco Sensitive Zones have been declared in the area towards seaward side from Marine National Park and Sanctuary and in the area of rivers connecting Marine National Park and Sanctuary.

- According to the GPS co-ordinates, A to H of map sent by your good office vide above referred letter, there is an Eco Sensitive Zone of rivers approximately 120 meters away from your refinery and petrochemical complex boundary and Eco Sensitive Zone towards seaward side of Marine National Park and Sanctuary is approximately 7.8 kms away.

True Copy
Fwayam

- According to the GPS co-ordinates, I to N of map sent by your good office vide above referred letter, there is an Eco Sensitive Zone of rivers approximately 530 meters away from your COT (Crude Oil Tankage) boundary and Eco Sensitive Zone towards seaward side of Marine National Park and Sanctuary is approximately 3.2 kms away.

According to the map sent here with subject to your reference letter, your refinery and petrochemical complex and COT area is outside the declared Eco Sensitive Zone area of Marine National Park and Sanctuary.

Deputy Conservator of Forest

Marine National Park, Jamnagar

True Copy

Tiwary

"Annexure 4"

No.16011/22/2000-IA-III
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan,
CGO Complex, Lodi Road,
New Delhi – 110 003

November 3, 2000

Sub : CRZ Clearance for construction of Jetty, approach to jetty, SBM and crude and product pipelines of M/s ESSAR Oil Ltd. at Vadinar, Jamnagar, Gujarat regarding.

Sir,

Reference is invited to the letter No. ENV-1096-GOI-1421-PI dated 5.7.2000 from Forests and Environment Department, Govt of Gujarat regarding the subject mentioned above. Subsequent information/documents submitted by M/s ESSAR Oil Limited vide their letter No. ES/OP/1536 dated 7th August, 2000, No. EOL/BOM-MOEF/dated 28th September, 2000 have been considered.

The proposal is for construction of a Single Buoy Mooring (SBM) at a distance of about 3 km from the second SBM of IOC in the deep sea, a product jetty, an approach to the jetty, crude and product pipelines, intake/return sea water pipeline and associated structures/facilities. The Land Fall point for the submarine pipeline will be on the Narara Bet at a distance of about 75 meters from the existing IOC pipelines. Thereafter the alignment of the pipeline will be on the existing bund almost parallel to the IOC pipeline corridor. The proposed site falls in the jurisdiction of Kandla Port Trust. The proposal has been examined in the Ministry of Environment and Forests and environmental clearance to this project is hereby accorded subject to the effective implementation of the following terms and conditions.

A. Specific Conditions.

1 All the conditions stipulated by Forests and Environment Department, Government of Gujarat as contained in their letter no. ENV-1096-GOI-1421-PI dated 5.7.2000 while according CRZ clearance and letter No. FCA-1096-1663-K dated 16.10.97 while granting permission for Right of Way through the Marine National Park/Sanctuary shall be effectively implemented.

2 All the conditions stipulated by the Forestry Wing of the Ministry of Environment and Forests while according forestry clearance vide their letter No. 8C/12/385/96-FCW dated 8.12.99 shall be effectively implemented.

3 The project shall be implemented in such a manner that there is minimum damage to the corals

True Copy
Tiwayam

(2/6)

4. Mangroves afforestation shall be taken up in at least 3 times the area of mangroves to the affected as a result of the project

5 No dredging, including maintenance dredging shall be undertaken for implementation of the project without prior approval of this Ministry.

6. The project authorities shall spell out the necessary precautionary measures to be taken to avoid any disturbance due to unequal settlement, while laying down the pipeline in the inter tidal area where the sub soil conditions are poor.

7 It shall be ensured that there is no displacement of fishing activity as a result of the project.

8. Worst case scenario of ship to ship collision shall be considered for risk assessment. The maximum quantity of crude which is likely to find its way into the coastal waters under different accident scenarios and their impact on aquatic life shall be studied after demarcating the impact zone. On the basis of such studies, the necessary action plan to mitigate the likely impacts shall be prepared before commencement of the operations. Action taken report in this regard shall be submitted to the Ministry.

9. A Disaster Management Plan and oil spill contingency plan should be prepared to take care of the large scale spillage including those in the event of any ship to ship collision, ship grounding etc.

10. The proposed location of control room should be re-examined to ensure the safety of the persons working there during any emergency situation.

11. Regular mock drills shall be carried out to ensure fitness of equipment in place.

12. It shall be ensured that due to the project, there is no adverse impact on the drainage of the area, recharge of ground water and the existing mangroves. The port should be equipped with skimmers, booms, absorbents, salvage pump, salvage barge, barriers and fire fighting equipments for handling the oil spill situation before the project is put into commission.

13 The project proponents should make specific arrangement for rain water harvesting in the project design and the rain water so harvested should be optimally utilized.

True Copy
Tiwari

(3/6)

B. **General Conditions :**

(i) Construction of the proposed structures should be undertaken meticulously conforming to the existing Central/local rules and regulations. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned State Government Departments/Agencies

(ii) The proponent shall ensure that as a result of the proposed constructions ingress of the saline water into the ground water does not take place. Piezometers shall be installed for regular monitoring for this purpose at appropriate locations on the project site.

(iii) A comprehensive contingency plan in collaboration with the concerned authorities must be formulated to contain in case of any oil spills. Appropriate devices such as oil skimmer, oil monitor, oil water separator must be acquired for strengthening the contingency plan. All the service vessels that are required for oil spill operations must be equipped with booms and dispersants. The personnel on board of these vessels must be properly trained in operation of these booms and dispersants.

(iv) The operation plan for responding to an oil spill must include clear procedures for notification of a spill, response decisions, clean up operations, communications, termination of cleanup operations, cleanup cost, oil pollution, damage control and disaster management plan.

(v) A well-equipped laboratory with suitable instruments to monitor the quality of air and water shall be set up so as to ensure that the quality of ambient air and water conforms to the prescribed standards. The laboratory will also be equipped with qualified manpower including a marine biologist so that the marine water quality is regularly monitored in order to ensure that the marine life is not adversely affected as a result of implementation of the said project. The quality of ambient air and water shall be monitored periodically in all the seasons and the results should be properly maintained for inspection of the concerned pollution control agencies. The periodic monitoring reports at least once in 6 months must be sent to this Ministry as well as its Regional Office at Bhopal.

(vi) The project affected people, if any should be identified and properly compensated and rehabilitated.

(vii) Adequate provisions for infrastructure facilities such as water supply, fuel for cooking, sanitation, etc. must be provided for the labourers during the construction period in order to avoid damage to the environment. Colonies for the labourers should not be located in the CRZ area. It should also be ensured that the construction workers do not cut trees and mangroves for fuel wood purpose.

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Tiwari

(viii) To prevent discharge of sewage and other liquid wastes in to the water bodies, adequate system for collection and treatment of the wastes must be provided. No sewage and other liquid wastes without treatment should be allowed to enter into the water bodies. The quality of treated effluents, emissions, solid wastes and noise levels must conform to the standards laid down by the competent authority including the Central/State Pollution Control Board.

(ix) Appropriate collection facility should be created for the solid and liquid wastes generated by the barges/vessels and their safe treatment and disposal should be ensured to avoid possible contamination of the water bodies.

(x) Necessary navigational aids such as channel markers should be provided to prevent accidents. Internationally recognized safety standards shall be applied in case of barge/vessel movements.

(xi) During operation phase proper precautions should be taken to avoid any oil spills and no oily wastes shall be discharged into the water bodies.

(xii) The project authorities should take appropriate community development and welfare measures for the villagers in the vicinity of the project site, including drinking water facilities. A separate fund should be allocated for this purpose.

(xiii) The quarrying material required for the construction purpose shall be obtained only from the approved quarries/borrow areas. Adequate safeguard measures shall be taken to ensure that the overburden and rocks at the quarry site does not find their way into water bodies.

(xiv) The maintenance dredging operations, if any required, should be executed with appropriate safeguard measures to prevent turbidity conditions in consultation with the expert agencies such CPWRS/NIO after obtaining prior approval of this Ministry.

(xv) For employing unskilled, semi-skilled and skilled workers for the project, preference shall be given to local people.

(xvi) To meet any emergency situation, appropriate fire-fighting system and water pipeline should be installed. Appropriate arrangements for uninterrupted power supply to the environment protection equipment and continuous water supply for the fire fighting system should be made.

(xvii) Regular drills should be conducted to check the effectiveness of the On-site Disaster Management Plan

(xviii) The recommendations made in the Environmental Management Plan and Disaster Management Plan, as contained in the EIA and Risk Analysis Reports of the project, shall be effectively implemented.

True Copy

Ewayaru

(5/6)

(xix) A separate Environment Management Cell with suitably qualified staff to carry out various environment related functions should be set up under the charge of a Senior Executive who will report directly to the Chief Executive of the Company.

(xx) The funds earmarked for environment protection measures should be maintained in a separate account and there should be no diversion of these funds for any other purpose. A year-wise expenditure on environmental safeguards should be reported to this Ministry.

(xxi) Full support should be extended to the officers of this Ministry's Regional Office at Bhopal and the officers of the Central and State Pollution Control Boards by the project proponents during their inspection for monitoring purposes, by furnishing full details and action plans including the action taken reports in respect of mitigative measures and other environmental protection activities.

(xxii) In case of deviation or alteration in the project including the implementing agency, a fresh reference should be made to this Ministry for modification in the clearance conditions or imposition of new ones for ensuring environmental protection. The project proponents should be responsible for implementing the suggested safeguard measures.

(xxiii) This Ministry reserve the right to revoke this clearance, if any of the conditions stipulated are not complied with to the satisfaction of this Ministry.

(xxiv) This Ministry or any other competent authority may stipulate any other additional conditions or modify the stipulated conditions, subsequently, if deemed necessary, for environmental protection, which shall be complied with.

(xxv) A copy of the clearance letter shall be marked to the concerned Panchayat/local NGO, if any, from whom any suggestion/representation has been received while processing the proposal.

(xxvi) State Pollution Control Board/Committee should display a copy of the clearance letter at the Regional Office, District Industries Center and Collector's Office/Tehsildar's Office for 30 days.

(xxvii) The project proponent should advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the Gujarat State Pollution Control Board and may also be seen at Website of the Ministry of Environment and Forests at http://www.envfor.nic.in/.

(xxviii) The Project proponents should inform the Ministry as well as its Regional Office at Bhopal, the date of financial closure and final approval of the project by the concerned authorities and the date of start of Land Development Work.

True Copy

Tiwary

(6/6)

The above mentioned stipulations will be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Hazardous Chemicals (Manufacture, Storage and Import) Rules, 1989, the Coastal Regulation Zone Notification, 1991 as amended in 1994 and July, 1997 and the Public Liability Insurance Act, 1991 and the Rules made thereunder from time to time. The project proponents should also ensure that the proposal complies with the provisions of the approved Coastal Zone Management Plan of Gujarat State and the Supreme Court's order dated 18th April, 1996 in the Writ Petition No. 664 of 1993 to the extent the same are applicable to this proposal.

(Dr. S.K. Aggarwal)
Additional Director

To

The Director,
Forests and Environment Department,
Block No. 14, 8th Floor,
Sachivalaya,
Gandhi Nagar -382 010,
Gujarat.

Copy to:

1. Managing Director, ESSAR Oil Limited, Khambhalia Port, PO Box 24, District Jamnagar 361 305, Gujarat.
2. Chief Conservator of Forests, Regional Office, Ministry of Environment & Forests, E-3/240, Arera Colony, Bhopal - 462 016.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 32.
4. The Chairman, Gujarat State Pollution Control Board, Sector 10 A, Gandhi Nagar, Gujarat 382043.
5. DIG (SU), Regional Office Cell, Ministry of Environment and Forests, New Delhi.
6. Guard File.
7. Monitoring Cell.
8. Sr. Adviser (H), Ministry of Environment & Forests, New Delhi.

(Dr S.K. Aggarwal)
Additional Director

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