Indian Oil

Final Environment Impact Assessment & Environmental Management Plan

FOR

Revamp of INDMAX unit at Guwahati Refinery

Submitted To

INDIAN OIL CORPORATION LIMITED

Refineries Division, Guwahati Refinery,
Maniram Dewan Road, Noonmati, Guwahati, Assam-781020

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EXECUTIVE SUMMARY

Executive Summary

Project Description

INDMAX is a high severity catalytic cracking process patented by IOC R&D to produce very high yield of light olefins and high octane gasoline from various hydrocarbon fractions. Demonstration unit of 0.1 MMTPA capacity based on in-house developed technology was commissioned at Guwahati Refinery (GR) in June 2003. The unit is designed to process residual feed comprising of Reduced Crude Oil (RCO), Coker Fuel Oil (CFO) and Coker Gasoline (CG). Since then, the unit is under normal operation giving a tangible benefit to the refinery. This unit has been operated under both LPG and gasoline mode as per the requirement. Guwahati Refinery (GR) intends to revamp INDMAX unit to increase capacity from 0.1MMTPA to 0.15 MMTPA.

Project at a Glance

S. No.	Items	Details
i.	Project Name	Revamp of INDMAX Unit at Guwahati Refinery of Indian Oil Corporation Ltd.
ii.	Location	IOCL, Guwahati Refinery, Noonmati, district Kamrup, Guwahati,
iii.	Type of Project	Expansion
iv.	Total Plant area	Existing area of the INDMAX Unit: 5200 m^2. No further area is required for the proposed revamp.
v.	Proposed capacity	Capacity expansion from 0.1 MMTPA to 0.15 MMTPA
vi.	Main Products	LPG, Gasoline
vii.	Air pollution control facilities	All air pollutants are well within the limit provided by MoEF, discharge through 50 m stack.
viii.	Effluent Management Facilities	Generated effluent will be treated in the existing ETP.
ix.	Solid waste management facility	Equilibrium catalyst (e-cat) withdrawn from the unit (59.4 MTPA max.) will be stored in the refinery, and used as and when required.
x.	Hazardous waste management facility	No Hazardous waste generated in the unit.
xi.	Greenbelt	As the plant is already in operation, hence no additional green belt will be created.
xii.	Additional water requirement	1 m^3/hr, which will be met from treated effluent.
xiii.	Estimated Power consumption for revamp case with heat integration	1600 kW
xiv.	Project Cost	32.37Crores INR

Project Proponent

Indian Oil Corporation Limited (IOCL) is a public sector undertaking company. Indian Oil is India's flagship energy major and the country's largest commercial enterprise with a turnover of Rs. 4,73,210 Crore and profits of Rs. 7,019 Crore for the year 2013-14. It is also the highest ranked Indian company in the prestigious *Fortune* 'Global 500' for the year 2006. Indian Oil emerged as the top company in oil trading amongst national oil companies in the Asia Pacific region, as per the annual survey conducted by Applied Trading Systems (AFS), Singapore for the year 2004. Indian Oil is the 20th largest petroleum refining company in the world. Indian Oil and its group companies account for 48% petroleum products market share, 34.8% refining capacity and 71% downstream sector product pipelines capacity in India.

Purpose of EIA study

As per the Environmental Impact Assessment (EIA) Notification dated 14th September 2006 and its amendment dated 1st December, 2009, the proposed INDMAX Revamp project falls under **'Category 4(A)'** petroleum refinery industry project requiring a prior environmental clearance from the Ministry of Environment and Forests (MoEF), GoI.

Project Location

The proposed project site is located within premises of Guwahati refinery of IOCL at Noonmati in Kamrup district of Assam state. Geographically, the INDMAX unit site is located at 26º11'05.09"N, 91º48'30.24"E, at a distance of about 7 km from Guwahati railway station and 30 km from Guwahati International Airport. The general topography of the area is flat surrounded by hilly regions and the general elevation of the site is 64 m masl.

Importance of the Project

The revamp project is being implemented for improvement profitability of the refinery through production of high value product like LPG and Gasoline.

In addition to that, with the use of the new Feed Injectors and Stripper Internals supplied by M/s Lummus Technology Inc, the yields of high-value products like LPG and gasoline are going to increase after revamp.

Process Description

INDMAX is a catalytic cracking process to produce very high yield of light olefins and high octane gasoline from various hydrocarbon fractions. The process of the INDMAX unit is similar to that of a conventional Fluidized Catalytic Cracking (FCC) unit.

Pollution Control System

As per the stack emission monitoring data , pollution estimation in revamp case by IOCL R&D, all pollutents are found well within the limit prescribed by MoEF for Refinery. Therefore, no pollution control system is required for the proposed INDMAX Revamp.

Raw Water Requirement

Make-up water requirement of the existing refinery and facilities is 455 m^3/hour. To meet this requirement, 290 m^3/hour is drawn from River Brahmaputra, and the balance 165 m^3/hour is met through recycle of treated effluents. The proposed Revamp of INDMAX Unit will increase the water requirement by 1 m^3/hour, which will be met from treated effluents. Thus, no additional fresh water will be required for the proposed revamp.

Description of the Environment

Study Period and Study Area

The baseline environmental status around the proposed project site has been established for the major environmental attributes, *viz.,* land, air, water, noise, ecology & bio-diversity and Socio-economics, during the pre-monsoon season, from 1st April to 30th June, 2014. Study area for baseline data generation and collection is the area falling within 10 km radius of the project site.

Land Environment

The project is located in Guwahati district in Noonmati village. A total 490 acre of land has been used for the IOCL Guwahati refinery. Existing area of the unit is 5200 m^2 and there is no additional land required for the project revampment.

Land use /Land Cover Map: Major part of the study area, comprising 350.98 sq km, lies in human settlements. The geographical area of all settlements covered within the study area is considered. The landuse is classified into six classes - viz. Agricultural Land, Settlement, Forest Land, Waste Land, Sandy Land & Water Bodies.

S.No	Classes	Area (sq.km)	Area in %
1	Agriculture	32.45	9.25
2	Settlement	132.75	37.82
3	Forest Land	82.98	23.64
4	Waste Land	2.12	0.60
5	Sandy Land	34.34	9.78
6	Water Bodies	66.34	18.90
Total		**350.98**	**100.00**

Soil quality: It may be noted from the results of analysis that many of the soil samples have alkaline pH while the Assam soil is acidic in nature. The soil texture is dominated by sandy clay in all the cases.

Climate & Meteorology

Guwahati's climate is generally described as temperate. The city's average yearly temperature is recorded at 24 degree Celsius (76°F). Average high temperature is recorded at 29 degree Celsius (85°F), while the average low at 19 degree Celsius (67°F). The highest recorded yearly temperature is 40 degree Celsius (104°F), while the lowest recorded yearly temperature is 5 degree Celsius (41°F). December, January and February are the coldest and June, July, August and September are the hottest. Average yearly precipitation is 161.3 cm (63.5 inches) with an average number of 77.3 rainy days. June and July are the wettest months. Extreme high level of humidity, many a times at more than 80/90 percent often creates discomfort during summer.

Air Environment

Ambient air quality survey was performed to determine the baseline 24-hour average concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2, HC's and VOC's at five locations within the study area, The studies were performed for the three months of the pre-monsoon season with the frequency of two days per week. The observed concentrations were well within the standards notified under National Ambient Air Quality Standards for industrial, rural, residential and other areas. The maximum observed concentrations of the pollutants at five sampling stations are as follows:

Sampling Location	**Maximum observed concentrations, µg/m^3**					
	PM_{10}	**$PM_{2.5}$**	**SO_2**	**NO_2**	**THC's (ppm)**	**VOC (as Benzene)**
Lachit Nagar	90	43	8.8	39	N.D	N.D.
Kahilipara	89	43	8.0	43	N.D	N.D.
Beltola	90	44	9.0	40	N.D	N.D.
Refinery Guest House	82	38	6.2	33	N.D.	N.D.
Panikhaiti Gaon	89	43	6.2	42	N.D.	N.D.
National AAQ Standards	100	60	80	80	N.A.	5

Based on the monitoring results, it is concluded that with respect to the ambient concentrations of air pollutants, the study area has adequate carrying capacity to sustain further industrial development.

Noise level

The main noise generating source in the study area of influence is traffic on the nearby road. Noise levels were measured, using an Integrating sound level meter, at five monitoring locations - four in residential areas, and one in commercial area (Beltola). Day and night time equivalent noise levels were computed from recorded hourly data. The observed values are well within the specified limits for respective area categories.

Water Environment

Water Source: Raw water from the River Brahmaputra is pumped into the Clarifloculators of Water Treatment Plant (WTP) where alum treatment is carried out for removal of suspended solids. Clarified water from the clarifloculators is stored in industrial reservoir from where the same is supplied to the Refinery and other users. WTP of Guwahati Refinery is located on top of the hill south of Refinery's housing colony, Sector-1 and is about 3 km from the Refinery. The plant was installed for supplying industrial and drinking water for the refinery township. It also caters to the requirements of some other nearby establishments including MES at Narengi. Fresh water consumption during the year 2013-2014 is as follows:

Industrial water pumped (all figures. in cu.m)	
	2013-14
Water pumped into WTP	11163944

Water flow out with sludge	223278
Clarified water supplied from wtp	10940666
Filtered water supplied to refinery township and other users	8246762
Clarified water supplied to refinery	2693904

Water Quality: To establish the water quality of the study area, 3 ground water and 4 surface water sources were identified and characterized. The ground water characteristics in the region have been compared with respect to the Drinking Water Quality Standards as per IS: 10500. The tested parameters are well within the permissible limits.

Biological Environment

Faunal diversity has been found inside the project area. It is found that there are twenty nine tree species, twenty eight herbs, elevan shrubs and one climber and one orchid species in the core area. The buffer area i.e. 10 KM radius of the refinery was surveyed for the study of Ecology & Biodiversity. Major parts of the study area includes the human settlement of the Guwahati city, however the Aamchung sanctuary and the Reserve forest, and Brahamputra rivers forms the part of the study area. The areas of Guwahati which come under 10 km radius of the refinery are Chandmari, Kamakhya, Khanapara, Hengerbarui & Ganeshguri etc.

Total 129 species are reported from buffer area. Out of which 34 tree species, 58 herbs, 16 shrubs, 10 climbers and 06 orchid species are reported from the buffer area.

The information of important terrestrial animal groups such as birds, reptiles and mammals were collected by trekking inhabiting area, along the road, nearby forest areas and agricultural fields present in the impact zone. An inventory of the animals has been prepared separately for mammals, reptiles and birds.

Socio-Economic Environment

There is a well developed society outside the refinery. It has all the infrastructural facilities required for routine work i.e. road, market, hospital, school etc. The population is having a good living standard. People living in the study area are primarily shopkeepers and run small business units. Some of the people are employed with various government and private enterprises.

Environmental Impact Assessment

Land Environment

Existing area of the unit is 5200 m^2 and there is no additional land required for the project revampment.

Air Quality

The major air pollutants likely to be emitted from INDMAX revamp are particulate matter, SO_2 and NOx from INDMAX stack. For the proposed project, computations of 24 hour average incremental ground level concentrations were carried out using ISCST-3 model, which is a recommended model by CPCB for prediction of air quality from point, area and line sources. The emission source details, used for the modeling, are as follows:

Stack Emission Details

Component	Units	Limits	Base Case (2012-13 Avg.)	Revamp Case
SPM	mg/Nm^3	100	88	< 57
SOx	mg/Nm^3	1700	125.2	144
NOx	mg/Nm^3	450	110.9	125
CO	ppmv	400	5.1	7.5
Opacity	%	30	27	25

Stack Emission Characteristics

Particulars	Base case	Revamp case
Mass flow rate, kg/hr	13962	16766
Volumetric flow, Nm^3/hr	11169.6	13412.8
Gas temperature. ^{0}C	470	488
Stack height, m	50	50
Stack ID at top, m	1.5	1.5
Pollutant concn, mg/Nm^3, max.		
Particulate matter	88	57
SO_2	125.2	144
NOx	110.9	125
CO	6.375	9.375
Flow rate, m3/h	30399.31	37388.79
Flow rate, m3/s	8.44	10.39
Area of cross section, m2	1.77	1.77
Efflux velocity	4.78	5.87
Emission rate, g/s		
PM	0.27	0.21
SO2	0.39	0.54
NOx	0.34	0.47
CO	0.02	0.03

Maximum Predicted Incremental Concentrations (24 hour average)

Component	Units	Limits	Base Case	Revamp Case
SPM	µg/m^3	100	0.49	0.324
SO_2	µg /m^3	80	0.697	0.805
NO_x	µg /m^3	80	0.625	0.697

Based on the modeling results under observed meteorological condition, 24 hours average maximum Ground Level Concentration (GLC) of, SO_2, NO_x and PM, in existing INDMAX unit are estimated to be 0.697, 0.625 and 0.49 µg/m^3 respectively and based on the modeling result under observed meteorological condition, 24 hours average maximum GLCs of SO_2, NO_x and PM in INDMAX revamp are estimated to be 0.805, 0.697 and 0.324 µg/m^3 respectively. Modeling result envisages that incremental ground level concentrations of modeled pollutants due to plant operation are not significant. The resultant concentration of SO_2, NO_x and PM pollutants are expected well within the NAAQS and hence, no significant impacts are envisaged on the surrounding area.

Water Resources

Make-up water requirement of the existing refinery and facilities is 455 m^3/hour. To meet this requirement 290 m^3/hour is drawn from River Brahmaputra, and the balance 165 m^3/hour is met through recycle of treated effluents. The proposed revamp of INDMAX Unit will increase the water requirement by 1 m^3/hour, which will be met from treated effluents. Thus, no additional fresh water will be required for the proposed revamp.

Water Conservation

Increase in quantity of fresh water requirement will be 1 m^3/hr, which will be met from recycle of treated effluent from the ETP.

Noise Level

Noise will be generated during the operational phase of the project. Noise limits from equipments are within defined limits.

Biological Environment

Construction phase: No construction required during INDMAX Revamp.

Operation phase: During the operation after INDMAX revamp, generated effluent will be treated in the existing ETP. It is est within the limit prescribed by MoEF. Hence, no adverse effect of the INDMAX revamp to the biological environment.

Impact on the Amchang sanctuary: The impact due to stack emission from the INDMAX stack pre and post revamp case to the Amchang sanctuary were evaluated using AERMOD (ISCST-3). It has been found out that there will be negligible increment in the GLC of various air pollutants such as SO_2, PM_{10} and NOx on and around the Amchang sanctuary.

Green belt and plantation: IOCL Guwahati refinery has well developed Green belt.

Socio-Economic Environment

The proposed revamp will not have any impact on demographic profile of the area and will not create additional direct employment. Some employment is envisaged in transportation of increased product output. However, it will generate additional revenue to the company as well as to the government through taxes. Overall, the project will have positive impacts on socio-economic environment.

Environment Monitoring Programme

The IOCL Guwahati refinery has a well established monitoring schedule for AAQ, Stack and effluent. As the INDMAX unit already existing within the refinery hence, this revamp case shall not attract any additional monitoring schedule and parameter. The refinery is already in complying with all the statutory norms related to environmental concerns of various state and federal agencies i.e. MoEF, CPCB & PCB Assam.

Additional Studies

A separate risk assessment and disaster management plan have been prepared for the refinery.

Project Benefits

Processing higher quantity of feed will increase the quantity of each product generated in the unit. In addition to that, with the use of the Feed Injectors and Stripper Internals supplied by M/S Lummus Technology Inc., the yields of high-value products like LPG and gasoline are going to increase after revamp.

Net total economic benefit estimated from the project is Rs 9.75 Crore/annum. The benefit was estimated based on the average product prices during 2011-14.

Environmental Management Plan

Solid & Hazardous Wastes

A total of 59.4 Tons (maximum) per Annum of e-cat (Equilibrium Catalyst) will be withdrawn from the unit. The catalyst withdrawn will be stored in the refinery and used as e-cat as and when required in the unit. Other solid waste generated from the INDMAX revamp will be sold to CPCB Authorized vendor.

Air Environment

All the emission from the INDMAX Stack is within the limit of MoEF and prediction from the air pollution dispersion modeling. No Additional air management required for the proposed INDMAX Revamp.

Water Environment

Make-up water requirement of the existing units and facilities is 455 m^3/hour. To meet this requirement, 290 m^3/hour is drawn from River Brahmaputra, and the balance 165 m^3/hour is met through recycle of treated effluents. The proposed revamp of INDMAX Unit will increase the water requirement by 1 m^3/hour, which will be met from treated effluents. Thus, no additional fresh water will be required for the proposed revamp.

Noise Environment

Provision of various control and mitigation measures will be kept during operational phase to reduce the noise. Some of them are maintenance and greasing of construction equipment, Ear-plugs/muffs for workers, provision of acoustic glass walls for control room etc.

Greenbelt Development

As the plant is already in operation with a good green belt, hence no additional green belt is needed.

Rain Water Harvesting

Rain water harvesting system is available in Guwahati Refinery. In this process the rain water will flow by gravity through the storm water drains into the rain water collection tank. The collection tank will be of adequate capacity to facilitate settling of suspended matter.

Corporate Social Responsibility

The project proponent, IOCL, is a Public Sector, and is well aware of its responsibility towards social upliftment. IOCL has been undertaking various welfare schemes around its existing operational Units, and has a track record of spending more on CSR than its commitments. IOCL will take up the matter with local authorities, enter into an agreement (MoU), and perform the CSR activities as per the MoU.

Occupational Health & Safety

IOCL has a well established OHS management plan which is in place. Various elements of the program are given below:

OH-MS Elements	Requirement
Leadership and Commitment	Commitment of the top management to good OH practices
Policy and Strategic objective	Organization's appreciation of all significant OH hazards for planning, hazard identification, risk assessment and risk control
Organization & resources	Organization of people, resources and documentation for good OH performance
Health Risk Assessment	Identification and evaluation of OH risks for the activities, products and services and development of risk reduction measures
Planning and Implementation	Planning and conduct of work activities including planning for changes and emergency response. Broadly the programs can be classified into Health protection and Health promotion programs
Monitoring and corrective actions	Performance and monitoring of OH activities and corrective action as necessary
Auditing and reviewing	Audit program and procedures for periodic audits to determine and review whether the OH management system conforms to the planned arrangement for OH-MS and commitment to continual improvement

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CHAPTER-1 : INTRODUCTION

1.1 Purpose of the Report

The purpose of EIA/EMP report is to reduce or/minimize undesirable or negative impacts and to enhance the positive impacts due to the project activities based on the conductance of EIA study by analyzing various environmental issues related to the proposed project activities.

Environmental Impact Assessment (EIA) is one of the tools available with the planners to achieve the above-mentioned goal. It is desirable to ensure that the development option under consideration shall be sustainable. In doing so, environmental consequences must be characterized early in the project cycle and shall account for the project design. The objective of EIA is, thus, to foresee the potential environmental impacts that would arise out of a proposed development and address them in the project's planning and design stage. The EIA process should then allow for the communication of this information to:

(a) The project proponent;
(b) The regulatory agencies; and,
(c) All stakeholders and interest groups.

EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. In doing so it can enable the integration of environmental concerns and mitigation measures in the project development. Hence, major aims of EIA are:

- The preparation of an Environmental Management Plan (EMP) to suggest appropriate mitigation measure to reduce adverse impacts, if any, with regard to the proposed development in accordance with relevant guideline and in a manner acceptable to be Regulatory Agencies.
- All necessary reports/documents to get the environmental clearance for the project as per the regulatory agencies.

M/s. Indian Oil Corporation Ltd. has proposed revamping of INDMAX unit at IOCL Guwahati Refinery, Guwahati. The objective of the study is to assess the environmental impacts of the proposed project. The net impacts from individual project can be identified through Environmental Impact Assessment studies of various components of environment such as noise, air, water, land, biological and socioeconomic. Rapid EIA studies from a basis for preparing an Environmental Management Plan (EMP) to conserve the environment of the area.

1.2 Project and Project Proponent

1.2.1 Project Proponent

Indian Oil is India's flagship energy major and the country's largest commercial enterprise with a turnover of Rs. 4, 73,210 crore and profits of Rs. 7,019 crore for the year 2013-14. It is also the highest ranked Indian company in the prestigious Fortune 'Global 500' for the year 2006. Indian Oil emerged as the top company in oil trading amongst national oil companies in the Asia Pacific region, as per the annual survey conducted by Applied Trading Systems (ATS), Singapore for the year 2004. Indian Oil is the 20th largest petroleum refining company in the world. Indian Oil and its group companies account for 48% petroleum products market share, 34.8% refining capacity and 71% downstream sector product pipelines capacity in India. For the year 2009-10, Indian Oil sold 60.7 million tonnes of petroleum products, including 1.91 million tonnes of natural gas, and exported 3.33 million tonnes of petroleum products. More than 10000 KM network of crude and product pipelines in India are owned and operated by IOCL, which have state of art, modern operation and maintenance techniques. These pipelines have been accredited with national and international certifications of repute such as ISO 14001, ISO 9002, OISD Safety Award, British Safety Council Award etc.

The proposed project for revamp of the INDMAX unit is to be located within premises of Guahati Refinery of Indian Oil Corporation Limited. Guwahati Refinery is one of the eight operating refineries owned by Indian Oil Corporation Limited, and is located among the picturesque surroundings near the Brahmaputra river at Guwahati in the northeast part of India. The refinery processes indigenously available crude of Assam and caters to the requirements of the petroleum products of the region. Inaugurated on 1 January 1962, Guwahati Refinery is the first public sector refinery in India and was built using Rumanian technology available in the late 50s. The original crude oil processing capacity of 0.75 MMTPA has been subsequently increased to 1.00 MMTPA. The crude oil is supplied from Assam fields by M/s OIL INDIA LIMITED through a crosscountry pipeline.

The project is located in the Noonmati village, Kamrup district, Assam. Indian oil corporation Limited (IOCL) proposes to revamp of INDMAX unit IOCL Refinery, Guwahati, Assam. IOCL seeks for the enhancement of the capacity from 0.1 MMTPA to 0.15 MMTPA. As per EIA notification 2006, MOEF, the project comes under the expansion category. Existing area of the unit is 5200 m^2 and there is no additional land required for the project revampment.

1.2.2 Project Proposal

Guwahati refinery of Indian Oil Corporation Limited operates an INDMAX Unit of 0.1MMTPA capacity. Indmax is a high severity catalytic cracking process patented by IOC R&D to produce very high yield of light olefins, high octane gasoline from various hydrocarbon fractions. The demonstration unit of 0.1 MMTPA capacity based on this in-house developed technology was commissioned at Guwahati Refinery (GR) in June, 2003.

The unit is designed to process residue feed comprising of Reduced Crude Oil (RCO), Coker Fuel Oil (CFO) and Coker Gasoline (CG). Since then, the unit is under normal operation giving a tangible benefit to the refinery. This unit has been operated under both LPG and gasoline mode as per the requirement. INDMAX unit was installed to maximize LPG and light olefin production from heavy petroleum fractions. INDMAX, Indane Maximization Process, developed by Indian Oil Corporation Limited (IOCL) is similar to conventional FCC process. In INDMAX, Coker Gasoline and heavy oils such as RCO, CFO are cracked to more valuable light and middle distillates such as LPG, Gasoline and Diesel.

The project proposal pertains to revamp the existing INDMAX Unit to enhance its capacity from 0.1 MMTPA to 0.15 MMTPA. Yield pattern of the unit before (actual) and after revamp (projected) are given in **Table-1** and **Table-2** respectively.

Table 1: Yield Pattern of the Unit (%)

Yield, wt %	Units	Base Case	Revamp Case
Dry Gas	Wt %	06.32	06.58
LPG	Wt %	24.82	25.00
Gasoline (C5-198^{o}C)	Wt %	38.32	39.50
TCO (198 – 358^{o}C)	Wt %	14.22	14.80
CLO (358^{o}C +)	Wt %	09.64	08.37
Coke	Wt %	06.68	05.75
Total Wt%		100	100

Table 2: Yield Pattern of the Unit (MTPA)

Yield,	Units	Base Case	Revamp Case
Dry Gas	MTPA	6320	9870
LPG	MTPA	24820	37500
Gasoline (C5-198^{o}C)	MTPA	38320	59250
TCO (198 – 358^{o}C)	MTPA	14220	22200
CLO (358^{o}C +)	MTPA	9640	12555
Coke	MTPA	6680	8625
Total		100000	150000

1.3 Nature, Size, Location and Importance

- Indmax is a high severity catalytic cracking process to produce very high yield of light olefins, high octane gasoline from various hydrocarbon fractions.
- 0.1 MMTPA to 0.15MMTPA

- The proposed revamp project is located within existing INDMAX unit of Guwahati Refinery premises.

1.4 Scope of Study

The scope of the study is to conduct the EIA study covering all the disciplines of environment and field monitoring in relevant disciplines over one year (excluding monsoon months). This Rapid EIA report is prepared as per approved ToR.

MoEF has granted the Terms of Reference vide Letter No. ***F. No. J-11011/71/2012- IA II (I)*** dated 10.09.2013 against the application ***HSE/EP/WU-5/EC-APPL/18*** dated 09.05.2013 submitted by the IOCL, Guwahati. Copy of the approved ToR has been attached as **Annexure-I**. MoEF Notification dated 14.09.2006. As per the Environmental Protection Act 1986 and its amendments in 2006, petroleum refinery industry project falls in the category of 4 (A) requiring a prior environmental clearance from the Ministry of Environment and Forests (MoEF), GOI. To obtain this clearance, preparing an Environment Management Plan (EMP) is a prerequisite for revamping of INDMAX unit projects.

It is inevitable to frame a picture of current environment in project area of INDMAX unit. This has been accomplished by carrying out a field survey and secondary data collection, based on which the mitigation measures have been suggested and the EIA report prepared. The Rapid EIA study of proposed project has been carried out as per the following methodology.

- Collection and review of information pertaining to existing environmental conditions in the areas, supported by field investigation in addition to consultation with IOCL and experts.
- Evaluation of all potential, significant, adverse, environmental and socio-economic impacts associated with the proposed project.
- Identification and planning of measures to mitigate potential significant adverse impacts. Preparation of detailed environment management plan to prevent, mitigate or compensate potential significant adverse impact identified.

1.4.1 ToR Compliance

MoEF has granted the Terms of Reference vide Letter No. F. No. J-11011/71/2012-IAII (I) dated 10.09.2013. ToR compliance has been given below in **Table-3**:

Table 3: ToR Compliance

S.No	Items in the letter of the TORs	Reply / Response by the PP
1.	Executive summary of the project.	Draft Executive summary submitted to the client. Final executive summary will be submitted after finalization of EIA report.
2.	Project Description and Project Benefits.	Project Description given in **Chapter-2** and Project Benefits given in **Chapter-8**
3.	Copy of environmental clearance accorded for all the existing projects along with point-wise compliance report.	Copy of environmental clearance accorded for all the existing projects are enclosed in **Annexure-IV, V and VI** alongwith pointwise compliance report.
4.	Location of National Park/Wild life sanctuary/Reserve Forest within 10 km radius of the project.	10 KM Study Map with Amchang wildlife sanctuary is attached as **Annexure III**
5.	Details of the total land and break-up of the land use for green belt and other uses.	Existing area of the INDMAX Unit is 5200 m^2. As the proposed project is to revamp the existing INDMAX unit, it does not need additional land requirement.
6.	List of products along with the production capacities.	List of product along with production capacity are given in **Table-1** and **Table-2**.
7.	Manufacturing process details along with the chemical reactions and process flow diagram for the proposed project.	Manufacturing process details given in **Chapter-2, Clause 2.8 page no. 23**
8.	Is there additional storage required for the proposed products mix, if yes details thereof.	No.
9.	Baseline data collection for air, water and soil for last one year.	Base line data collection for air, water, and Soil are given in **Annexure-X**
10.	Ambient air quality monitoring for $PM_{2.5}$, PM_{10} SO_2, NOx, (methane & non-methane HC) and VOCs.	The result of analysis of various ambient air quality parameters are given through **Table-22** to **Table-28**.
11.	Existing status of stack emission, raw water requirement, treated effluent quantity & quality data, noise pollution and solid waste management in the existing units.	Existing stack emissions are given in **Annexure-X** Raw water requirement is given in **Chapter 2.10 Figure-10** Treated effluent quality and quantity are

S.No	Items in the letter of the TORs	Reply / Response by the PP
		given in **Chapter-2.14**
12.	Status of stack emission, raw water requirement, treated effluent quantity & quality data, noise pollution and solid waste management after proposed product mix.	Stack emissions post revamp of INDMAX unit is attached in **Table 42**. Additional water requirement 1m^3/hr No change in effluent quality (effluent treated in existing ETP), Noise pollution – No change. Solid waste management: Disposal of spent catalyst to the authorized CPCB Vendor.
13.	Details of Sulphur balance in the existing refinery unit.	Sulphur balance is given in **Table 9**
14.	Additional SO_2 emissions due to the proposed product mix.	Minimum increment in SO_2 concentration. Base case 125.2, Revamp Case 144 mg/NM^3
15.	A note on how SO_2 and NO_X will be controlled at the existing level leading to no increase in pollution load.	There is minimal increment in SO_2 and NOx concentration.
16.	Unit-wise air pollution control devices to be installed. For the proposed units.	According to online data logger and continuous stack emission monitoring of existing INDMAX Unit, and post revamp emission predicated by IOC which is given in Table-42 clearly shows that stack emissions post INDMAX Revamp meets all norms therefore no air pollution control device required in revamp case.
17.	Source and permission of water supply.	Source of Raw water is Brahmaputra river. Water Cess payment being done to PCB, Assam for consumption of water from river Brahmaputra.
18.	Water balance chart for proposed project. Measures for conservation water by recycling and reuse to minimize the fresh water requirement.	Details of water balance chart are given in **Table-7 and Table -8.**
19.	Detailed solid waste generation, collection, segregation, its recycling and reuse, treatment and disposal.	During revamp case, main solid waste will be Catalyst and Coke fines from Main Fractionator Bottom Pump strainers during periodical cleaning. The spent

S.No	Items in the letter of the TORs	Reply / Response by the PP
		catalyst will be disposed off as per existing practice.
20.	Details of membership of TSDF for hazardous waste disposal.	No. TSDF available in Assam.
21.	Details of proposed preventive measures for leakages and accident.	Developed a plan and timetable for repairing components. Make a first attempt to repair as soon as possible after a leak is detected. Monitor components daily and over several days to ensure a leak has been successfully repaired. Replace problem components with "leakless" or other technologies. Proposed INDMAX Revamp project is a part of existing ERDMP report of IOCL Guwahati.
22.	Environmental Management Plan	Detail Environmental management plan is given in **Chapter 10**
23.	Risk Assessment & Disaster Management Plan Identification of hazards Consequence Analysis Risk assessment should also include leakages and location near to refinery & proposed measures for risk reduction.	Detail of Risk Assessment & Disaster Management Plan are given in **Annexure-VII** and **Annexure-VIII**
24.	Total capital cost and recurring cost/annum for environmental pollution control measures.	As the INDMAX Unit is well established within the refinery premises no additional environmental pollution control measure required. Only continuous monitoring will be carried out after INDMAX revamp.
25.	Environmental Monitoring programme.	Environmental Monitoring programme is given in **Chapter 6**
26.	Any litigation pending against the project and /or any direction /order passed by any Court of Law against the project, if so, details thereof.	No.

S.No	Items in the letter of the TORs	Reply / Response by the PP
The following general points should be noted:		
(i)	All documents should be properly indexed, page numbered.	Complied
(ii)	Period/date of data collection should be clearly indicated.	Complied
(iii)	Authenticated English translation of all material provided in Regional languages.	Will be complied
(iv)	The letter/application for EC should quote the MOEF file No. and also attach a copy of the letter.	File no of the EC application is "**F. No. J-11011/71/2012- IA II (I)**". Copy of the ToR letter is attached as **Annexure-I**.
(v)	A copy of the letter received from the Ministry should be also attached as an annexure to the final EIA-EMP Report.	ToR is attached as **Annexure-I**
(vi)	The final EIA-EMP report submitted to the Ministry must incorporate the issues in this letter. The index of the final EIA-EMP report must indicate the specific chapter and page no. of the EIA-EMP Report where the above issues have been incorporated.	ToR compliance of EIA INDMAX Unit Project is attached in page-12 of subchapter 1.4.1 of **Chapter 1.**
(vii)	'Certificate of Accreditation' issued by the QCI to the environmental consultant should be included.	Attached as **Annexure-XIII**

CHAPTER-2:
PROJECT DESCRIPTION

CHAPTER-2 : PROJECT DESCRIPTION

2.1 Introduction

Guwahati Refinery is one of the eight operating refineries owned by Indian Oil Corporation Limited, and is located among the picturesque surroundings near the Brahmaputra River at Guwahati in the northeast part of India. The refinery processes indigenously available crude of Assam and caters to the requirements of the petroleum products of the region.
Inaugurated on 1st January 1962, Guwahati Refinery is the first public sector refinery in India and was built using Rumanian technology available in the late 50s. The original crude oil processing capacity of 0.75 MMTPA has been subsequently increased to 1.00 MMTPA. The crude oil is supplied from Assam fields by M/s OIL INDIA LIMITED through a cross-country pipeline.

The main products currently manufactured in Guwahati Refinery are:

1. Liquefied Petroleum Gas (LPG)
2. Motor Spirit (MS)
3. Superior Kerosene Oil (SKO)
4. Aviation Turbine Fuel (ATF)
5. High Speed Diesel (HSD)
6. Light Diesel Oil (LDO)
7. Sulphur (S)
8. Low Sulphur Heavy Stock (LSHS)
9. Raw Petroleum Coke (RPC)

2.2 Type of Project

INDMAX is a Residue Fluidized Catalytic Cracking technology developed indigenously by IOCL – R&D for upgrading low-value feedstocks to high-value products like LPG, Gasoline and Diesel. Guwahati Refinery (GR) intends to revamp INDMAX unit capacity from 0.1 to 0.15 MMTPA.

The project falls in the **Category 4(A)** as this is a petroleum refinery industry. It is mandatory for the project proponent to get the Environmental Clearance from MoEF as the capacity of existing unit is going to be increased from 0.1 MMTPA to 0.15 MMTPA. Salient features of the project are given in **Table-4**.

Table 4: Salient Features of the project

S. No.	Items	Details
i.	Project Name	Revamp of INDMAX Unit at Guwahati Refinery of Indian Oil Corporation Ltd.
ii.	Location	Noonmati, Guwahati Municipal Corporation, Kamrup, IOCL, Guwahati Refinery.
iii.	Type of Project	Expansion
iv.	Total Plant area	Existing area of the Unit: 5200 m^2 No further area is required for the proposed revamp.
v.	Proposed capacity	Proposed revamp Capacity from 0.1 MMPTA to 0.15MMTPA
vi.	Main Products	LPG, Gasoline
vii.	Air pollution control facilities	All air pollutants are well within the Limit provided by MoEF , discharge through 50 m. stack.
viii.	Effluent Management Facilities	Generated effluent will be treated in the existing ETP.
ix.	Solid waste management facility	Equilibrium catalyst (e-cat) withdrawn from the unit (59.4 MTPA max.) will be stored in the refinery, and used as and when required.
x.	Hazardous waste management facility	No Hazardous waste generated in the unit.
xi.	Green belt	As the plant is already in operation, hence no additional green belt will be created.
xii.	Raw water requirement	1 m^3/hr
xiii.	Estimated Power consumption for revamp case with heat integration	1600 kW
xiv.	Project Cost	32.37 Crores INR

2.3 Need for the Project

The Indane Maximization (INDMAX) technology developed by R&D Centre of Indian Oil installed at the Refinery is designed to achieve LPG yield as high as 44% through Fluidized Catalytic Cracking of residual feed stocks like Reduced Crude Oil, Coker Fuel Oil and Coker Gasoline. The INDMAX unit also enables Guwahati Refinery to upgrade all its residual products to high value distillate products and make it a zero residue Refinery. Revamp of Indmax unit to 0.15 MMTPA will enable Guwahati refinery to increase LPG and MS Production.

2.4 Location

The proposed project site is located within premises of Guwahati refinery of IOCL at Noonmati in Kamrup district of Assam state. Geographically, the INDMAX unit site is located at 26º11'05.09"N, 91º48'30.24"E, at a distance of about 7 km from Guwahati railway station and 30 km from Guwahati International Airport. The general topography of the area is flat surrounded by hilly regions and the general elevation of the site is 64 m amsl. The layout plan of the project with demarcation of the project boundary is attached as **Annexure-II**. A map showing 10 KM study area is also attached as **Annexure-III**.

2.5 Size or Magnitude of Operation

Guwahati Refinery (GR) intends to revamp INDMAX unit capacity form 0.1 MMTPA to 0.15 MMTPA.

2.6 Proposed Schedule for Approval and Implementation

2.6.1 Pre-Project Activities

Status of various pre-project activities is given below:

Item	Status/ Details
Clearance and approval of the project by the Board of the company	Board Approval obtained
Firming up of arrangement for supply of raw materials	Feed for the unit is sourced from the refinery; no new raw materials are required
Firming up of arrangement for supply of power & water	Additional power and water, if any, required after revamp will be from the existing facilities in the refinery
Selection of Engineering Consultant	M/s EIL is the Detailed Engineering Contractor for the project and Detailed Engg has been completed.
Preparation of Environmental Impact Assessment (EIA) study and getting Environmental Clearance from Ministry of Environment & Forest.	Final EIA Report preparation is in progress. After completion it will be submitted to MoEF for obtaining EC.
Obtaining financial clearance and commitment from financial institutions and creditors for financial closure of the project, if required	Not Applicable for the project
Mobilization of resources for revamp work	Lining up of agencies/ contractors required for execution of the revamp work is under progress
Drawing up of a project implementation plan on the basis of a network of activities	Project implementation plan has been finalized and is scheduled for implementation during Dec '15-Jan '16.

2.6.2 Project Implementation Period

All the project execution related activities, as mentioned earlier, are interlinked and have impact on the final outcome. The execution of the relevant project activities has to be planned and controlled in such a way that the goals of the project are achieved in the set time frame. The basic design and detailed engineering has been completed. The critical items shall be procured from the reputed vendors.

2.6.3 Statutory Requirement

The INDMAX unit is under operation, and it is proposed to revamp the capacity of the unit from 0.1 MMTPA to 0.15 MMTPA. However before commencement of revamp work, the following statutory environmental clearances are required:

1. Environmental clearance form MoEF
2. Consent to Established from Pollution Control Board, Assam
3. Consent to operate from Pollution Control Board, Assam

For the existing INDMAX unit of 0.1 MMTPA capacity, the company had applied for NOC and received the same from Pollution Control Board, Assam vide letter no **WB/Z-III/T-1986/98-99/21** dated **04.08.1998 (Annexure-IV)**. Having received NOC from PCB, Assam, the company has moved forward to MoEF for getting EC for the project "installation of the ISOSIV unit for production of unleaded MS (110,00 MTPA) & INDMAX Unit to maximize LPG production (44290 MTPA), and later for MS Quality Improvement project vide letter no **J-11011/215/2007-IA-II (I)** from MoEF dated 07.02.08 **(Annexure-V)**.

Table 5: Statutory Requirement

Date	Application /Clearance	Letter No	Issued by
04.08.1998	NOC	WB/Z-III/T-1986/98-99/21	Pollution Control Board, Assam
30.12.1999	EC Application	EP/EC-APPL	IOCL
28.04.2000	EC for Installation	J-11011/1/2000/IA-II(I)	MoEF, New Delhi
07.02.2008	EC for MS Quality Improvement	J-11011/215/2007-IA-II (I)	MoEF, New Delhi

2.7 Technology and Process Description – Existing Units

2.7.1 Process Units

Guwahati Refinery has a capacity to handle 1 MMTPA crude oil.

The existing units with their capacities are presented in **Table-6**. The actual production achieved during the financial year 2013-14 is presented in **Table-7**.

Table 6: Existing Units at Guwahati Refinery

Units	Installed Capacity (MMTA)	Year of Commissioning	Licensor

CDU	1	Revamped 1986 & 2000	RUMANIAN / EIL
DCU	0.33	1962	RUMANIAN
NSF	0.13	1984	EIL
HDT	0.66	2002	UOP
HGU	10 TMTA	2002	TECHNIP BENELUX
SRU	5 TPD	2002	EIL
INDMAX	0.1	2003	IOC-R&D
MSQ	0.05	2010	AXENS

Table 7: List of Products alongwith Production Capacity

Item	**Production Capacity 2013-14 (TMT)**
Crude	1019.034
LPG	45.031
SRN	29.450
MRN	1.509
MS-BS-II	0.000
MS-BS-III	122.708
LT. DIST	138.416
% ON CRUDE	**13.583**
AFT	47.037
SKO	58.809
HSD BS-II	0.000
HSD BS-III	705.341
LDO	5.260
MID. DIST	707.981
% ON CRUDE	**69.476**
TOTAL DIST	846.397
% TOTAL DIST.	**83.06**
CLO	0.747
SULPHUR	0.749
RPC	61.151
HY.ENDS	62.647
%ON CRUDE	**6.148**

The refinery has a captive thermal power station (TPS) inside the refinery that generates and supplies electric power and process steam. TPS consists of two chains of DM plant, 4 boilers of 20 T/Hour, 1 boiler of 40 T/Hour and 2 boilers of 50 T/Hour capacity as well as 2 TGs of 8 MW and other one 12 MW capacity is being installed. Three new air compressors are also installed to supply air to the instruments and the plant.

The other facilities consist of Crude oil, intermediate and product tanks, Hydrogen and Nitrogen storage bullets, tank wagon loading /unloading gantry, tank truck loading/ unloading gantries, LPG storage and dispatch facilities. There is a well equipped Laboratory and a modern effluent treatment plant besides fresh water supply from the river Brahmaputra to the Refinery and other end users. The main process units in the refinery are as follows:

2.7.2 Crude Distillation Unit (CDU)

The Crude Oil is pumped to unit by the unit feed pumps from the storage tanks at an average temperature of 30°C and passes through heat exchangers. In the heat exchangers, the incoming feed exchanges heat with the hot stream products, thereby attaining a temperature of 200 °C before entering the pre-topping column CL-1. The feed entering CL-1 is flashed and the overhead gases and light gasoline vapours from the top of the column are condensed in the heat exchangers, overhead condensers and enter in the reflux drum. Condensate from reflux drum goes to LPG stabilizer as feed for LPG production.

The skimmed crude at 187 °C comes out from the bottom of the column CL-1 and pumped through heat exchangers where it is heated upto 263 °C by exchanging heat with RCO coming from CL-2 bottom and Gas oil circulating reflux. Then the skimmed crude enters first in the convection zone and then the radiation zone of the vertical balanced draft heater.

The heated skimmed crude at 363 °C is delivered through a overhead transfer line to the main fractionator column CL-2. MP steam at 240 °C is introduced at the bottom of the column to strip off lighter fractions from reduced crude oil. The overhead vapour from CL-2 is condensed and goes to the NSF Unit as feed along with stabilized gasoline obtained from stabilizer bottom for Light Naphtha, Reformer Naphtha and Heavy Naphtha production.

Two circulatory refluxes of Kero-II & SRGO are withdrawn, cooled and returned to the column for better control of vapour liquid traffic in the column. Three side streams viz. SR Kero-I, II & SR Gas Oil are also drawn from CL-2 which enter the stripping column CL-3, in the different sections. Steam is introduced in all the sections of the column CL-3 to strip off lighter components, which then go back to main fractionators' column CL-2.

SR Kero-I after exchanging heat with NSF feed, gets cooled to 36 °C and goes to the rundown tank. Similarly SR Kero-II & SRGO are cooled in crude heat exchangers and then in coolers and sent to respective rundown tanks. Reduced crude from the bottom of CL-2 is pumped through crude oil heat exchangers. Reduced crude oil is then sent to DCU as hot feed or to rundown tank via RCO cooler for storage.

2.7.3 Naphtha Splitter Facility (NSF)

Naphtha Splitter Facility in Guwahati Refinery was commissioned in 1984 in order to meet the Reformer naphtha requirement of BGR. The feed stock for the unit is the combined stabilized gasoline & heavy gasoline of CDU (Combined ASTM range being IBP-130 °C).

The light gasoline is first stabilized in stabilizer column C-003 & LPG is recovered. The heavy gasoline ex CDU main-fractionator (CL-2) is received in NSF surge vessel V-001 via caustic wash vessel V-3. The stabilized gasoline ex C-003 bottom & heavy gasoline ex surge vessel V-001 after getting heated upto 115 °C enter splitter one column C-001. From splitter C-001 top light naphtha having ASTM range IBP-120 °C goes to MS pool/ISOSIV Feed & HGU Feed. The heat from vaporization in this column is supplied by routing a part of the bottom product through the reboiler Furnace F-001. The liquid bottom product from C-001 is further separated in the second column C-002 giving bottom product as Heavy naphtha with ASTM FBP upto 240°C (routed to HSD) and Reformer Naphtha (routed to AOD / MS pool). The heat from vaporization in this column (C-002) is supplied by routing a part of the bottom product through the reboiler Furnace F-002.

2.7.4 Delayed Coking Unit (DCU)

The feed is RCO and it is directly taken from CDU RCO R/D at 100 Deg C or from tanks at about 90 °C. Clarified Oil (CLO) Ex INDMAX is also processed in DCU. Feed pump P1 takes suction and discharge passes through feed preheat exchangers, where it gets heated from about 254 °C. This heated feed then goes into main distillation column partly in vapour zone above flash zone and partly in liquid zone below flash zone.

The fractionator column bottom material (secondary feed) is pumped to heater by a multistage pump P2/2A.The flow to heater is divided equally into 4 passes at heater inlet. Fractionators bottom is heater upto 501 deg C in the balanced draft heater furnace equipped with an Air pre-heater. At the furnace outlet BFW injected in all four passes to avoid coking in transfer line from heater to coke chamber. Process fluid ex heater goes to coke drums through the 4-way valve.

In coke chamber cracking and polymerization reactions take place from which Gas, LPG, CGO, CG, CFO& RFO generated along with RPC. Gases containing all products are routed to main fractionator's flash zone through quench column where CGO reflux is used to quench the vapors to avoid further polymerization.

The vapors from the quench column 03-CL-1 at about 425 °C enters in the flash zone (34 trays) of main fractionating column (03-Cl-02. A temp gradient is maintained in distillation column with top reflux. Top temp is maintained at about 90 °C and bottom at about 365 °C.

The products CK-I, CGO & CFO are steam stripped in stripper column (03-Cl-03A/B/C) having 4 trays each. The vapors from strippers are returned to the main column (2 trays above draw off) and the liquids are pumped under level control and sent to run down tanks after exchanging heat and cooling in run down coolers with circulating water.

The overhead vapors from main fractionators are cooled in condensers S-2A to E TO 40 °C and taken to reflux vessel 03-V-0I. The incondensable gases under pressure control goes to fuel gas system/ LPG recovery section. The condensed liquid is partly refluxed back to control column to temp of 40 °C and excess liquid under level control goes to Cl-20.

2.7.5 LPG Recovery Unit

In LPG Recovery Unit Coker off gases are compressed followed by absorption of C-3/C-4 components with Naphtha and separation of C-3/C-4 from rich Naphtha in stabilizer. 3 nos. of reciprocating compressors have been provided with a capacity of 2750 kg/h each for compressing the coker off gases up to 15 kg/cm2. Normally two compressors are in operation and one is standby. The compressed gas after being cooling to 40 °C is routed to absorber with 44 nos. of valves trays. Stabilized gasoline enters 44th tray and unstabilized gasoline enters 40th tray for absorption of C-3/C-4 components. Condensate generated at interstage / afterstage cooler of compressor is also transferred to absorber. MP steam heated reboiler is provided at the bottom to stip-off C-1/C-2 components. The rich solvent from bottom of the absorber is feed to stabilizer column (04-Cl-04) where gasoline is stabilized by removing LPG. From stabilizer top LPG sent to bullets after caustic wash and gasoline from bottom sent to tanks for storage.

2.7.6 Hydrotreatment Facilities

Hydrotreatment Facilities are installed at Guwahati Refinery for improving the stability and Cetane No. of HSD meeting BS-II specification, Smoke point of Kerosene streams and for upgradation of feed kerosene streams to SKO and ATF. The treatment facilities consist of the following units:

- Hydrotreating Unit (Capacity : 600 TMTPA)
- Hydrogen Unit (Capacity : 10 TMTPA)
- Amine Treating Unit (Capacity : 10 m^3/hr)
- Sulfur Recovery Unit (Capacity : 5 TPD)
- Sour Water Stripping Unit (Capacity : 13 m^3/hr)

The **Hydrotreating unit** (HDT) operates in three blocked out modes of operation, viz., ATF mode consisting of SR Kero-I, Kerosene mode consisting of SR Kero-I and SR Kero-II and HSD mode consisting of SR Kero-II. SR Gas Oil, Coker Kero-I, Coker Gas Oil & TCO.

Hydro processing technology is a proven and widely used technology licensed by several reputed licensors like UOP, IFP etc. Guwahati Refinery has opted for UOP's 'Distillate Unionfining' Technology for this unit.

For supplying Hydrogen gas to HDT unit, a **Hydrogen unit** is installed based on Steam Reforming Technology of KTI using a mixture of light naphtha (SRN) and off gases ex LPG Recovery Unit (LRU) as primary feed. For providing flexibility in feed composition, a pre-reforming step applied upstream of Reformer using steam reforming technology from M/s Technip, Italy. After the shift conversion, Pressure Swing Adsorption (PSA) process of UOP applies to produce high purity hydrogen product from raw hydrogen. For supplying hydrogen during start-up of hydrogen generation unit two hydrogen bullets are installed in the refinery with flexibility of unloading hydrogen from potable cylinders.

In order to remove H_2S from gaseous feed of Hydrogen unit, the wet gas obtained from Delayed Coker Unit (DCU) and HDT treated in **Amine Treating Unit** (ATU) which is combination of AAU and ARU. **Amine Absorbers Unit** (AAU) generates rich amine. The generated rich amine from (AAU) is sent to **Amine Regeneration unit** (ARU) where Stripping of H2S is done and regenerated lean amine. The lean amine is reused in AAU for treating wet gas obtained from DCU from 5500 kg/hr of DCU and 940 kg/hr of HDT wet gases. The Process licensor of this unit is KTI, BV.

As a part of Hydrotreatment Facility, a Sour Water Stripper (SWS) is also install to strip of H_2S from sour water coming from HDT unit and existing DCU based on UOP'S technology. The Acid gas recovered from stripper is sent to Sulfur Recovery Unit.

Acid gases from ATU and SWS are fed to **Sulfur Recovery Unit** (SRU). In SRU, H_2S present in the feed gas gets converted to elemental Sulfur. SRU of Guwahati Refinery is based on '3 Stage Modified Claus Process' having a single chain of 5.0 TPD capacity. AAU, ARU and SWS are a part of SRU and installed at one place is called **Sulfur Block**.

2.7.7 INDMAX Unit

Indmax is a high severity catalytic cracking process patented by IOC R&D to produce very high yield of light olefins, high octane gasoline from various hydrocarbon fractions viz., and naphtha to resids. Demonstration unit of 0.1 MMTPA capacity based on this in-house developed technology was commissioned at Guwahati Refinery (GR) in June'03.

The unit is designed to process resid feed comprising of Reduced Crude Oil (RCO), Coker Fuel Oil (CFO) and Coker Gasoline (CG). Since then, the unit is under normal operation giving a tangible benefit to the refinery. This unit has been operated under both LPG and gasoline mode as per the requirement. A detailed process description is attached as **Annexure-VII**.

INDMAX unit is installed to maximize LPG and light olefin production from heavy petroleum fractions. INDMAX, Indane Maximization Process, developed by Indian Oil Corporation Limited (IOCL) is similar to conventional FCC process. In INDMAX, Coker Gasoline and heavy oils such as RCO, CFO are cracked to more valuable light and middle distillates such as LPG, Gasoline and Diesel. The capacity of INDMAX unit is 100,000 TPA. INDMAX unit consists of the following sections:

- Feed Storage and Pumping Section
- Reaction and Regeneration Section
- Fractionation Section
- Gas Concentration Section
- LPG/ Gasoline Treatment Section

RCO and CFO will be preheated to 180-220 deg.C in heat exchanger with steam. Preheated feed will contact catalyst at 700 deg C in the riser. On contact with catalyst feed will get cracked to lighter HC's and the final temperature will be 585 deg C. Cracked vapors will be separated from catalyst in the riser and reactor cyclone. Vapors from riser cyclone will go to main column via vapor line where separation of HC's in the various streams will take place.

Main column over heads are separated into Gas, LPG and Gasoline in the Gas Concentration section consists of wet gas compressor four columns and set of exchangers and vessels etc. LPG and Gasoline are caustic washed to remove H2S and then water washed to remove entrained caustic. Diesel withdrawn from the column goes to diesel pool as well as for flushing oil after stripping in stripping column.

Main part of the main column bottom is recycled to column as quench and wash. Rest of the bottom materials is clarified in either slurry settler or slurry filter and sent to tanks as clarified oil.

Catalyst from reactor stripper after stripping out entrained HC's gets back into the regenerator through spent catalyst standpipe. Spent catalyst is regenerated in the regenerator by combustion of coke formed on the catalyst with air. Specially designed air grid ensures uniform distribution of air in the regenerator. Air blower supplies air for coke burning. Regenerated catalyst travels back to riser through regenerated catalyst standpipe.

Combustion gases form the regenerator at temperature of 730 deg C with catalyst enters regenerator primary and secondary cyclone to knock down the catalyst. Hot flue gases from regenerator passes through Double Disc Slide Valve to the Orifice Chamber where the pressure of the gases is reduced from 2.5 kg/cm2 to 0.2 kg/cm2. Heat of hot flue is removed in WHB by generating HP Steam.

Fresh and equilibrium catalyst are stored in two different hoppers with requisite loading unloading provision. Apart from these two hoppers automatic catalyst loading system has been installed from M/s Intercat for smooth catalyst handling and continuous catalyst loading. The unit has a dedicated flushing oil system. Flushing oil is required during the normal operations as well as during shutdown/ start up.

With the MS quality up gradation project, a 3-cut splitter facility was added in INDMAX unit as Object-55. A combined feed stream of wild naphtha and INDMAX (FCCU) Gasoline is routed to 3-cut splitter column located at eastern side of existing INDMAX unit, wherein the feed stream split up into 3 fractions:

- Top Cut (Light Gasoline, TBP Boiling Range: C5-70 deg C) High Octane and Low Aromatics stream. The same is directly routed to MS pool.
- Middle Cut (Heart Cut, TBP Boiling Range: 70-90 deg C rich in Benzene, Sulphur, Aromatics and Olefins-hence, cannot be directly absorbed in Euro-III Grade MS pool. This stream is routed to 56 unit as feed for NHDT, followed by further treatment in ISOM and DIH sections.
- Bottom Cut (Heavy Gasoline, TBP Boiling Range: 90-200 deg C) can be absorbed in MS pool or DHDT (Diesel Hydrotreater) feed.

2.7.8 ISOSIV Unit

To produce unleaded gasoline and high octane product, ISOSIV unit is chosen based on technology supplied by UOP. The feed of this unit is Light Naphtha (50-140 ^{o}C) from NSF and its capacity is 130,000 TPA. In this unit, Normal paraffin in the feed are separated from Non-normal and aromatics, using molecular sieve beds.

It provides a mean for separation of Normal paraffinic components from Non-normals and aromatics of Gasoline boiling range material. Naphtha (Gasoline boiling range) is vaporized in a furnace and passed through the molecular sieve adsorbent beds. The normal paraffins get adsorbed in the adsorbents while the non-normals and aromatic materials pass through the adsorbent beds. The unabsorbed non-normals and aromatic components of naphtha are condensed and stabilized in the stabilizer before it is sent as high octane Naphtha (Gasoline).

The adsorbed normal paraffins are desorbed from the adsorbent beds by purging with hot Hydrogen gas. There are four absorber vessels filled with adsorbents. At any time of operation each adsorber vessel will be at different stages of adsorption and purging mode of operations.

Each step is essentially a batch operation. However, the piping and sequencing valves allowing flow into or out of each absorber are designed to permit continuous separation of the normals from the adsorber feed streams.

Subsequently, the purged out normal paraffins and Hydrogen gas are cooled, normal paraffins get condensed and separated from Hydrogen gas in a separator. The separated normal paraffins are stabilized in a stabilizer before it is sent as normal paraffins/ naphtha product.

2.7.9 ISOM Unit

Straight Run Light Naphtha Splitter Column, a Naphtha Hydrotreater (NHDT), an Isomerisation Unit (ISOM) and De-Iso-Hexanizer (DIH) Column have been installed in ISOM unit for production of Euro-III Grade MS in Guwahati Refinery. New Light Naphtha Splitter, NHDT, ISOM and DIH forms part of the object-56 unit and the same is located at the eastern side of existing ISOSIV unit.

A new light naphtha splitter column is for reduction of C7+ hydrocarbon compound content to below 2%wt in light naphtha feed to NHDT unit for protection of NHDT catalyst. Straight Run Light Naphtha from the top of the new light naphtha splitter along with Heart Cut from 3-Cut Splitter (55 unit) is routed to NHDT for catalytic hydrotreatment for removal of sulphur content. This is essential in view of stringent sulphur specifications in post Euro-III Grade MS scenario (150 ppm, max).

In next processing stage, Isomerisation of the hydro treated feed naphtha is carried out in a series of two fixed bed reactors. Isomerisation is the conversion of hydrocarbons to their isomers, which have the same molecular formula but a different arrangement of molecules. The C5 /C6 Isomerisation Unit specifically converts the normal C5/C6 paraffins to their isomers, i.e. to a higher octane branched arrangement, over a proprietary platinum catalyst in the presence of hydrogen. The conversion per pass of the normal paraffins to their isomers is determined by the reaction equilibrium at the reactor operating conditions. The low octane methyl-pentanes and the unconverted n-hexane are recycled back to the isomerisation reactors to achieve the objective of a RON clear 87.0 according to the guaranteed value.

A Deisohexanizer (DIH) column is used for recovering and recycling the low octane methyl-pentanes and the unconverted n-hexane from the reactor effluent. The Deisohexanizer distillate and bottoms streams are combined to produce the final isomerate product. A stabilizer is used for removing light ends from the reactor effluent, before sending it to the de-isohexanizer. The off gas from the unit contains hydrogen and chloride, which is removed by neutralisation with caustic soda in a Caustic Scrubber.

2.7.10 Flare System

Hydrocarbon flare lines from HDT, Hydrogen unit, INDMAX and ISOSIV is connected with the new flare header (36”). There is other header provided called 10” sour flare header from SRU, ATU & SWS is connected to the existing flare at the tip. Sour gas KODs is provided in the Sulfur block as well as near flare stack. The Sour flare header laid on the support of existing flare header. The existing flare contains a Knock out drum, a water seal drum and a flare stack. Two skid mounted Liquid ring compressors, a cooler and a three phase separator from M/s Garo, Italy is being installed at the flare site for recovery of HC under CDM project.

2.7.11 Flare Gas Recovery System

The flare gas recovery system installation in Guwahati Refinery was conceived as an energy conservation project. The flare gas recovery system is comprised of two liquid ring compressors, a three-phase separator, an exchanger and associated piping. The flare gas skid mounted package was supplied by M/s Garo, Italy. The benefits achieved by commissioning of the project are:

(a) Reduction in average flares loss,

(b) Reduction in average CO_2 emission to atmosphere

Liquid ring compressors compress gas isothermally i.e. within 10 deg C of the compressor seal liquid (DM water) temperature, making it less sensitive to molecular weight variability. Compression of gas is carried out through formation of liquid ring inside the casing of the compressor, which eliminates chance of equipment damage by virtue of liquid carryover from gas, variation in molecular weight of gas, frictional damage through mechanical rotating parts. Liquid seal is maintained by DM water. Compressed gas is separated in three-phase separator after cooling the same in the exchanger. Separated fuel gas is routed to refinery FG network, sour water is routed to OWS and liquid hydrocarbon is routed to slop tank at OM&S.

2.7.12 Offsite Facilities

Guwahati Refinery is having 74 storage tanks (54 old and 19 new tanks and 1 new tank under construction) for storing of Crude Oil, intermediate products & finished product tanks. Their details are given in Table 3.

The finished products are dispatched from the refinery to meet the region’s demand through product pipe line, tank Lorries and tank wagons. A tank lorry gantry exists with 26 loading points and a tank wagon gantry with 59 loading points.

After meeting the local demand for petroleum products, the excess products are pumped to Siliguri/Betkuchi through the 426 km long Guwahati – Siliguri product pipeline. This product pipeline is also India’s first public sector product pipeline.

This facility include two hydrogen bullets of 100 M3 capacity at a pressure of 50 kg/cm2, one loading/ unloading hydrogen compressor and the facility for unloading H2 from cylinders.

There are two LPG mounded bullet of 750 m3 capacity each, two LPG Horton sphere of 400 m3 capacity each to store it. LPG is dispatched through tank truck Lorries on weight basis. Tank details of the existing refinery is given in Table-8

Table 8: Details of Various Tank

SN	Tank No	Service	Capacity (kL)	Roof Type	Dia (m)	HT (m)
1.	2	RCO	5000	FIXED ROOF	22.8	11.7
2.	3	IFO	5000	FIXED ROOF	22.8	11.7
3.	4	RCO	5000	FIXED ROOF	22.8	11.7
4.	5	RCO	5000	FIXED ROOF	22.8	11.7
5.	6	RCO	5000	FIXED ROOF	22.8	11.7
6.	7	RCO	5000	FIXED ROOF	22.8	11.7
7.	8	RCO	5000	FIXED ROOF	22.8	11.7
8.	9	MS	5000	FLOATING ROOF	22.9	13.6
9.	10	MS	5000	FLOATING ROOF	22.9	13.6
10.	11	MS	5000	FLOATING ROOF	22.9	13.6
11.	12	HSD	5000	FIXED ROOF	22.3	11.7
12.	13	SKO	5000	FIXED ROOF	22.8	11.7
13.	14	HSD	5000	FIXED ROOF	22.8	11.7
14.	15	TCO	2000	FIXED ROOF	15.25	11.74
15.	16	SKO	2000	FIXED ROOF	15.25	11.74
16.	17	SLOPS	2000	FIXED ROOF	15.25	11.74
17.	18	CLO	2000	FIXED ROOF	15.25	11.74
18.	19	RCO	5000	FIXED ROOF	22.8	11.7
19.	20	LDO	5000	FIXED ROOF	22.8	11.7
20.	21	HSD	5000	FIXED ROOF	22.8	11.7
21.	22	HSD	5000	FIXED ROOF	22.8	11.7
22.	23	HSD	5000	FIXED ROOF	22.8	11.7
23.	24	RFO	5000	FIXED ROOF	22.8	11.7
24.	25	IFO	5000	FIXED ROOF	22.8	11.7
25.	26	MS component	5000	FIXED-FLOATING	22.9	13.0
26.	27	MS component	5000	FIXED-FLOATING	22.9	13.0
27.	28	HSD	5000	FLOATING ROOF	22.9	13.6
28.	29	HSD	5000	FLOATING ROOF	22.9	13.6
29.	56	SLOPS	1500	FIXED ROOF	12.00	13.26
30.	58	HSD	5000	FLOATING ROOF	22.9	13.00
31.	59	HSD	5000	FLOATING ROOF	22.9	13.00
32.	60	SLOPS	2000	FIXED ROOF	12.0	8.93
33.	70	ATF	2000	FIXED ROOF	15.00	12.6
34.	78	ATF	2000	FIXED ROOF	15.00	12.6
35.	79	ATF	2000	FIXED ROOF	15.00	12.6
36.	80	CRUDE OIL	10000	FLOATING ROOF	32.5	14.43

37.	81	CRUDE OIL	10000	FLOATING ROOF	32.5	14.43
38.	82	CRUDE OIL	10000	FLOATING ROOF	32.5	14.43
39.	83	MS component	2000	FLOATING ROOF	16.0	12.00
40.	84	NAPHTHA	2000	FLOATING ROOF	16.0	12.00
41.	00B1	LDO	200	FIXED ROOF	6.68	6.87
42.	00B2	MS	200	FIXED ROOF	6.68	6.87
43.	00B3	MS	200	FIXED ROOF	6.68	6.87
44.	00B4	EHN	700	FIXED ROOF	10.00	9.8
45.	00B5	HSD	700	FIXED ROOF	10.00	9.8
46.	00B6	MS component	500	FLOATING ROOF	10.00	9.8
47.	00B7	MS component	500	FLOATING ROOF	10.00	9.8
48	001A	RN	2000	FLOATING ROOF	16.00	12.00
49	001B	RN	2000	FLOATING ROOF	16.00	12.00
50	001C	RN	2000	FIXED-FLOATING	16.00	12.00
51	ODH1	SLOPS	400	FIXED ROOF	7.3	8.67
52.	ODH2	SLOPS	400	FIXED ROOF	7.3	8.67
53.	85	LIGHT NAPH.	5000	FLOATING ROOF	23.0	14.0
54.	86	LIGHT NAPH.	5000	FLOATING ROOF	23.0	14.0
55.	87	MS component	5000	FLOATING ROOF	23.0	14.0
56.	88	MS component	5000	FLOATING ROOF	23.0	14.0
57.	89	HDT-ATF	5000	FLOATING ROOF	23.0	14.0
58.	90	HDT-KERO	5000	FLOATING ROOF	23.0	14.0
59.	91	HDT-KERO	5000	FLOATING ROOF	23.0	14.0
60.	92	HDT-KERO	5000	FLOATING ROOF	23.0	14.0
61.	93	NAPHTHA	5000	FLOATING ROOF	24.0	11.1
62.	94	SKO	5000	FLOATING ROOF	24	11.1
63.	95	MRN	1000	FLOATING ROOF	12.0	11.0
64.	96	MRN	1000	FLOATING ROOF	12.0	11.0
65.	97	CFO	1000	FIXED ROOF	12.0	11.0
66.	98	CFO	1000	FIXED ROOF	12.0	11.0
67.	99	HDT-HSD	10000	FIXED-FLOATING	34.0	11.1
68.	100	HDT-HSD	10000	FIXED-FLOATING	34.0	11.1
69.	101	HDT-HSD	10000	FIXED-FLOATING	34.0	11.1
70.	102	HDT-HSD	10000	FIXED-FLOATING	34.0	11.1
71	103	NAPHTHA	2000	FIXED-FLOATING	12.0	14.5
72	104	NAPHTHA	2000	FIXED-FLOATING	12.0	14.5
73	105	NAPHTHA	2000	FIXED-FLOATING	12.0	14.5
74	106	MS	5000	FIXED-FLOATING	15.0	20.6

75	107	MS	5000	FIXED-FLOATING	15.0	20.6

2.7.13 Effluent Treatment Plant

Effluent Treatment Plant (ETP) of Guwahati Refinery is in operation since inception of the refinery, which was commissioned in the year 1962. Initially, ETP was having API separator along with aeration facility and the Treated effluent was meeting the then standards.

The ETP was modernized in the year 1976-77 with the addition of Chemical and Biological Treatment facilities, to meet MINAS (Minimal National Standards) norms. The ETP had two channels of capacity 800 M3/Hr each.

The ETP was modernized again in the year 2006-07,with the addition of latest techniques like two Equalization tanks to regulate flow rate and to stabilize pollutants load for enhancing effective treatment of wastewater, the TPI (Tilted Plate Interceptor) unit for removal of free oil and suspended solids, the DAF (Dissolved Air Floatation) unit for removal of emulsified oil and suspended solids, the Aeration Tanks for growing of micro-organisms are to metabolize their own protoplasm without replacement since the concentration of food available is at a minimum and to generate less solid-waste, Two nos. of Centrifuges(Sludge De-watering) System for removing of oil from accumulated sludge to less than 10% and latest filtering system i.e. PSF (Pressure Sand Filter) and ACF (Activated Carbon Filter) for removal of turbidity.

The Effluent Treatment Plant thus consists of Physical Treatment Section, Chemical Treatment Section, Biological Treatment Section and Polishing section.

The treated effluent is reused for coke cutting and pressurizing the fire water network. The excess treated water is routed to Treated water sump, from which it is pumped to River Brahmaputra through a 26 KM long underground pipeline. This is discharged near the Saraighat Bridge at the downstream of Guwahati city.

2.7.14 Eco-Friendly Operation

The Indane Maximization (INDMAX) technology developed by R&D Centre of IndianOil installed at the Refinery is designed to achieve LPG yield as high as 44% through Fluidized Catalytic Cracking of residual feed stocks like Reduced Crude Oil, Coker Fuel Oil and Coker Gasolene. The INDMAX unit also enables Guwahati Refinery to upgrade all its residual products to high value distillate products and make it a zero residue Refinery.

2.8 Proposed Revamp of INDMAX Unit

2.8.1 Introduction

INDMAX is a high severity catalytic cracking process developed by IOC R&D to produce very high yield of light olefins, high octane gasoline from various hydrocarbon fractions. Flow scheme in the Indmax unit is similar to that in a conventional Fluidized Catalytic Cracking (FCC) unit. Demonstration unit of 0.1 MMTPA capacity based on this in-house developed technology was commissioned at Guwahati Refinery (GR) in June’03.

The unit was designed to process resid feed comprising of Reduced Crude Oil (RCO), Coker Fuel Oil (CFO) and Coker Gasoline (CG). Since then, the unit is under normal operation giving a tangible benefit to the refinery. This unit has been operated under both LPG and gasoline mode as per the requirement.

2.8.2 Details of Revamp Project

Guwahati Refinery (GR) intends to revamp INDMAX unit to increase capacity to 0.15 MMTPA. Increase in processing capacity is planned to be achieved through modifications in the equipment within the existing unit. Process packages for the revamp project have been prepared by IOCL-R&D, Licensor of Indmax Technology and M/s Lummus Technology Inc, the Joint-Licensing partner of IOCL-R&D for global commercialization of INDMAX technology. The project is expected to increase the revenue of the refinery by producing higher quantity of high-value products. Total capital cost for the project is estimated at Rs 32.37 Crores.

2.8.3 Modifications in the Revamp

Revamp objectives can be achieved by modifications within the existing unit. No additional land or site is required for the proposed capacity augmentation. Following are the major modifications planned during revamp:

Reactor-Regeneration Section

1. Replacement of existing Reactor cyclones and Regenerator cyclones with new cyclones of higher capacity and efficiency
2. Replacement of existing Mixed Feed Injectors with new proprietary MicrojetTM Mixed Feed Injectors (4 nos.) supplied by M/s Lummus Technology Inc.
3. Replacement of existing disc-and-doughnut type baffles of reactor stripper by ModGridTM Stripper internals supplied by M/s Lummus Technology Inc.
4. Modification of plugging pattern in the orifice chamber.

Gas Concentration Section

1. Replacement of three existing heat exchangers with new high capacity heat exchangers.
2. Replacement of two existing pumps with new pumps and addition of two new pumps.
3. Replacement of four trays in Main Fractionator column.
4. Replacement of control valves.

2.8.4 Process Description

Feed to the INDMAX unit consists of Coker Fuel Oil (CFO), Reduced Crude Oil (RCO) and Coker Gasoline (CG) in various proportions. Feed streams are received from respective tanks. Coker Gasoline at temp of 30-40°C is pumped by CG feed Pump (P-02 A/B) and directly injected in the bottom of the riser through nozzle (053-SP-11). The feed streams, CFO and RCO are received at battery limit at 70-80°C and atmospheric pressure are pumped by RCO/CFO pumps (P-01 A/B/C), mixed by static mixer (053-M-16) and sent to Feed Surge Drum (V-01). The mixed feed, which is at a temperature of 70-80°C in V-01, is pumped by Mixed Feed Pump (P-03 A/B) to HP steam heater (E-08) followed by Feed/MCB Exchanger

(E-01A/B) for exchanging heat with Main Column (C-01) bottom liquid, which is heated up to 180°C. This feed is then injected into the riser through a dedicated mixed feed nozzles (053-SP-10A/B/C/D) just above CG feed entry point. These spray nozzles are installed around the riser so that uniform distribution of mixed hydrocarbon feed takes place. This will ensure proper mixing of catalyst and hydrocarbon feed vapors in the riser. In order to maintain low hydrocarbon partial pressure in riser and to reduce the residence time of reactants, dilution steam is injected through a dedicated dilution steam nozzle (053-SP-17A/B) located on riser well above mixed feed nozzles, enabling significant reduction in thermal cracking. As soon as the feed comes in contact with the hot catalyst, it vaporizes & heat up to the reaction temperature and the cracking reaction starts immediately. The cracking reaction is endothermic and the hot catalyst supplies the required heat. The catalyst gets deactivated due to formation of coke.

The catalyst along with hydrocarbon product vapor enters the riser cyclone (053-CY-01) mounted inside the reactor (053-R-02). This cyclone separates about 99.9% of the catalyst from the product vapors. Catalyst fines escaped from riser cyclone enters reactor cyclone (053-CY-02), wherein further separation of catalyst from product vapors occurs. Steam is injected in to the reactor shell at a location close to the inlet mouth of reactor cyclone to quench the product vapors thereby minimizing post riser cracking. Thereafter the product vapors from the outlet of the reactor cyclone pass through the overhead line to the main fractionator column (053-C-01).

The catalyst particles separated from the riser & reactor cyclones enters the catalyst stripper (053-R-03) through respective cyclone diplegs. This catalyst contains coke and adsorbed hydrocarbon vapors. These hydrocarbon vapors are entrained in the pores of each catalyst particle and in the void spaces between the catalyst particles. These hydrocarbons are removed in the stripper using steam as a stripping media.

The stripper is equipped with inclined (45o) perforated baffles (053-SP-12) for efficient countercurrent contact of steam and catalyst. The countercurrent contact of catalyst and steam increases the stripper efficiency. MP steam is injected for stripping the hydrocarbon vapors through three number of steam rings viz. lower (053-SP-09), middle (053-SP-08) and upper (053-SP-07). The stripped catalyst called as spent catalyst still contains coke and some amount of adsorbed hydrocarbons. This spent catalyst is routed to regenerator (053-R-04) through spent catalyst slide valve (053-SP-01) to burn off the coke and regenerate the catalyst for the next reaction cycle. The level of catalyst in the stripper is maintained by the spent catalyst slide valve. The flow of spent catalyst to regenerator takes place due to the gravity head generated by the catalyst bed in stripper. Also differential pressure between the reactor and the regenerator is very critical, which maintains the gradient required for the flow of spent catalyst. The spent catalyst standpipe (053-SP-04) contains an expansion joint (053-CP-01B), which takes care of the contraction/expansion of reactor and the regenerator. For free movement and to prevent catalyst build up in slide valve bonnets, these parts are provided with aeration facility.

Coke laden (spent) catalyst from the stripper needs to be regenerated to restore its activity so that it becomes ready for the next cracking cycle. In the regenerator, coke on the catalyst is

burnt with hot air, which restores the activity of the catalyst. Since the burning of coke is an exothermic reaction, lot of heat is generated in the regenerator. This hot catalyst is the means of transferring the heat from the regenerator to the riser/reactor. Energy required to vaporize/heat the feed and endothermic heat of reaction is supplied by the hot catalyst.
The regenerator also acts like a catalyst surge vessel and most of the catalyst inventory of the reactor-regenerator system is present in the regenerator. Coke deposition on the catalyst is temporary deactivation of the catalyst. In addition permanent deactivation of the catalyst also takes place due to hydrothermal deactivation, vanadium poisoning etc. To compensate permanent deactivation of the catalyst, addition of fresh catalyst is required. Also to keep the total reactor regenerator system catalyst inventory at normal levels, some amount of equilibrium catalyst withdrawal from the regenerator may also be required.

The extent of coke burning in the regenerator is controlled with the flow rate of air supplied. Most of the coke should burn in the dense bed of the regenerator. To prevent the afterburning in the dilute bed, temperature differential between the dense bed and dilute bed is controlled via manipulating the airflow rate to the regenerator.

Air is supplied through Main Air Blower (MAB) (053-K-02), which is a motor driven centrifugal type, equipped with an air filter (053-G-02) in the suction line. The MAB discharges air at about 247^{0}C and 3.5 kg/cm2g pressure. The discharge header is provided with the blower anti surge controller, which actuates a control valve venting air to atmosphere. The vent line has a silencer (053-M-05) to control the noise level of blowing air.
The air from MAB passes to Direct Fired Air Heater (DFAH) (053-F-01) through a silencer (053-M-20). The DFAH will be used only during startup. The air is uniformly distributed in the regenerator by an air grid (053-SP-06). Proper air distribution is necessary to avoid hot spots and bypassing in the dense bed. The regenerator is normally operated in turbulent fluidization regime. The spent catalyst enters the regenerator just above the dense bed through spent catalyst standpipe ((053-SP-04). The regenerated catalyst exits from bottom conical portion of regenerator and flows to riser through regenerated catalyst standpipe (053-SP-05). This standpipe also contains an expansion joint (053-CP-01A).

The flue gas produced in the regenerator passes through one set of two-stage cyclone system supported from the top of the regenerator. Most of the entrained catalyst with flue gas is separated in primary cyclone (053-CY-03) and remaining catalyst is separated in secondary cyclone (053-CY-04). Flue gas from the outlet of the secondary cyclone is routed to orifice chamber (053-V-20). The orifice chamber is a vessel with perforated plates inside. The regenerator top pressure is maintained at desired set value (1.80 kg/cm2g) by controlling differential pressure between reactor and regenerator through the adjustment of opening of the Flue Gas Slide Valve (053-SP-03), which is a double disc slide valve located on the flue gas line u/s of orifice chamber. The flue gas is passed through an orifice chamber to reduce its pressure very near to atmospheric so that it can be supplied to Waste Heat Recovery Section (053-E-18/17/16) or vented safely to the atmosphere through flue gas stack (053-M-01). Orifice chamber holds backpressure downstream of double-disc slide valve. By reducing the pressure drop across slide valve, operating life of slide valve is greatly extended by avoiding sudden accelerations of catalyst, bearing flue gas stream.

The flue gas from the orifice chamber is at temperature of about 700-720^{O}C. The sensible heat of this flue gas is utilized for generating superheated steam. The boiler feed water at 105^{O}C and 45-kg/cm^{2}g is passed through BFW pre-heater (053-E-16) coils where it exchanges heat with the flue gas exiting the waste heat recovery section. Then preheated BFW is fed to the steam drum (053-V-21) in which the water level is maintained. Steam at 38 kg/cm^{2}g is generated in the steam generator (053-E-17) and superheated to 450^{o}C in steam super-heater (053-E-18). The superheated steam at 38 kg/cm^{2}g is exported to HP steam header at the battery limit. A portion of BFW (2.0 % max) from the steam drum is blown to the blow down drum (053-V-23).

The flue gas cools down to about 150^{o}C after passing through the heat recovery coils. The flue gas is then vented to the atmosphere through flue gas stack (053-M-01). The flue gas pipe expansion joint (053-CP-02B) before the flue gas stack takes care of the expansion between WHR ducts and stack section. In the event of abnormality of the WHR section, flue gas is bypassed to the stack through a bypass line. The expansion joint (053-CP-03) takes care of thermal expansion in this line.

The reactor effluent, comprised of cracked hydrocarbon vapors, steam and inert gas at a temperature of 550^{0}C and a pressure of 1.4 kg/cm^{2}g, enters the main column at the bottom of the quench section, below tray no. 30, where the superheated cracked vapors and inert are cooled and heavier product is condensed. The small amount of entrained catalyst in the product vapors is scrubbed out, which drops to the bottom along with the condensed product. MP steam is added to main column bottom to strip off 370^{0}C^{-} components.

C-01 bottom liquid is pumped by Main Column Bottom (MCB) Pump (053-P-08A/B) to tray no.23 of C-01 and remaining is routed to Feed/MCB exchanger (E-01A/B), where this liquid is cooled to around 310^{0}C. This stream is further divided into three parts.

1. One part is sent to tray no. 23 of column C-01 as quench medium to de-superheat the hydrocarbon product vapors.
2. The second part is routed to column bottom/boot as bottom quench to maintain column bottom temperature at 350-360^{O}C to avoid coking in the MCB circuit. In order to avoid coking in the MCB temperature below 360^{0}C and a liquid velocity in the range of 5-7 ft/s (1.5-2.1 m/s) is to be maintained. Provision is also kept to inject MP steam below the bottom tray to minimize coke formation and to maintain catalyst and coke particles in suspension.
3. The third part of the stream is routed to CLO Cooler (E-03F) through a pump (P-30A/B), where DM water is preheated to about 90^{o}C. Some part of this stream is routed to column bottom as bottom quench. E-03A/B/C/D coolers are provided at the downstream of E-03F for further cooling. The cooled CLO product is sent as a rundown flow at 85^{o}C and 6-kg/cm^{2}g to battery limit. Main column bottom level is controlled through a level controller provided in CLO run down line.

The C-01 overheads vapor contains Dry gas, LPG, Gasoline and water, which are passes through air fin cooler (AC-01A/B/C/D) and further cooled in Trim cooler (E-04) to about 40oC. The condensed liquid and uncondensed gases from E-04 are sent to main column reflux drum (V-02), where the uncondensed dry gas and LPG are separated from the mixture. Part of the condensed liquid, which is unstabilized gasoline, is sent as reflux from V-02 to C-01 by main column reflux pump (P-04A/B/C) while the remaining unstabilized gasoline is pumped to Primary Absorber (C-03) by unstabilized gasoline pump (P-05 A/B). The uncondensed gas from the reflux drum V-02 flows to the wet gas compressor knock out drum (KOD), V-03 in the recovery section. Condensed sour water is collected in the boot of V-02. Part of this sour water is pumped by Wash water pump (P-13 A/B) to C-01 overhead section and rest is sent to Sour water Stripper outside the battery limit.

TCO stream is drawn from tray no. 18 of C-01. One part of this stream is pumped by TCO circulating pump (P-06 A/B) to get cooled in C2 Stripper reboiler (E-12) and is returned back as Pump around / Circulating Reflux on tray no. 16 of column C-01. The remaining part of TCO is withdrawn and routed to TCO stripper (C-02) top for stripping of light hydrocarbons. TCO stripper is equipped with 8 nos. of trays. The set temperature of the C2 stripper reboiler outlet vapors at the exchanger (E-12) outlet controls the draw of TCO pump-around. MP steam is used as stripping medium in C-02 to strip off light ends. Good stripping helps to ensure a satisfactory TCO flash point. The stripped TCO is pumped through P-07A/B to TCO product absorbent/C2 stripper feed exchanger (E-05 & E-06) for cooling and the same is further cooled in TCO product absorbent cooler (E-07). The cooled TCO product is divided into two streams. One part is used in the sponge absorber (C-04) as lean oil and the remaining part is drawn as TCO product to the OSBL tank. In all the above streams, individual flow controllers are provided to set the required flow. The rich oil from the sponge absorber (C-04) bottom is then returned to the main column (C-01) after joining TCO PA stream. Column C-04 level is controlled by adjusting the rich oil flow to C-01. The main purpose of routing of rich oil to C-01 is to recover the light ends absorbed in the sponge absorber. A new HCO pump around has been provided in revamp in addition to existing TCO PA and CLO PA. HCO PA stream will be drawn from tray 22 and pumped by P-32 A/B to heat Stabilizer reboiler(E-13) bottom and is returned back as Pump around on tray no. 19 of column C-01. The set temperature of the Stabilizer reboiler outlet vapors controls the draw of HCO pump-around stream. The main purpose of gas concentration section is to separate dry gas, LPG and stabilized gasoline from wet gas and unstabilised gasoline coming from V-02. The gas concentration section mainly consists of Wet Gas Compressor K-01 (WGC), Primary Absorber (C-03), Sponge Absorber (C-04), C2 Stripper (C-05) and Stabilizer/Debutanizer (C-06).

The wet gas from the main column reflux drum (V-02) consisting of dry gas, LPG and un-stabilized gasoline is sent to Stage-I Knock out Drum (KOD) V-03, where entrained liquid is separated. The vapor from V-03 then flows to the first stage of the Wet Gas Compressor (K-01A/B). WGC is a two stage motor driven reciprocating compressor. The compressed gas then flows through K-01A/B Inter stage Cooler (E-09A/B), which is a water cooled heat exchanger and enters stage- II KOD (V-04A/B) where medium pressure distillate along with sour water is separated from the uncondensed vapors. The uncondensed vapors from V-04A/B top are again compressed in the Stage-II of the Wet Gas compressor (K-01A/B) to a pressure of 16.0 kg/cm^{2}g. Part of hot discharge gases is sent back to C-01 overhead line as a spill back and rest of these gases along with condensed liquid from V-04, rich oil from primary absorber and the top vapors from the C2 stripper are brought to K-01A/B after stage cooler (E-10). This mixture is cooled to $40^{0}C$ and then is routed to HP separator (V-05) for separation of uncondensed vapors, the high-pressure distillate and sour water from light gases. The sour water from the HP separator boot is mixed with the sour water from main column O/H reflux drum boot and sent to the OSBL sour water stripper. The water flows by pressure differential between the HP separator and the main column O/H reflux drum boot water pump discharge.

The uncondensed vapors from V-05 are routed to the primary absorber (C-03) for recovering C3's and C4's. The primary absorber is a 40 tray tower designed to recover 95% of the propane / propylene in the reactor effluent. The un-stabilized gasoline from main column overhead receiver V-02 enters at tray no. 9 of C-03. Cooled stabilized gasoline from stabilizer/debutanizer (C-06) is fed on tray no. 1 of C-03. C-03 is provided with inter stage cooler (E-15) in order to remove the heat of absorption. E-15 also helps in removing condensed water, which is collected in the boot. Absorption is a physical mass transfer operation characterized by its exothermic nature i.e., absorption of C3's into the gasoline increases the temperature of the resulting rich liquid. The unabsorbed vapors (containing some amount of C3's & C4's and entrained C5's) from C-03 are routed to the sponge absorber (C-04) for recovering C3's, C4's and C5's. The rich oil from the bottom of the absorber C-03 is pumped through P-12A/B to WGC stage-II discharge line. The liquid level in C-03 bottom is controlled by manipulating flow at P-12A/B discharge. The sponge absorber is a 20-tray tower for recovering C3's, C4's and C5's entrained in the absorber gas from the primary lean oil. The lean oil used for absorption is cooled TCO from the TCO stripper (C-02). The rich sponge oil leaves the bottom of the sponge absorber on bottom level control and is routed back to the main column for recovery of the light ends (C3s, C4s and C5s). The sponge gas (dry gas) from the sponge absorber flows to the outside battery limit on pressure control through dry gas KOD (053-V-30).

The liquid from V-05 is pumped through Pump (P-11 A/B) to E-05 and E-06, where it is heated against TCO stripper bottom stream (TCO product + Lean Oil). The hot HP separator liquid level is maintained by adjusting discharge flow of P-11 A/B. In order to control the vapor pressure of the recovered LPG product stream, the inerts, C2's and lighter hydrocarbons from the liquefied C3+ hydrocarbon stream are removed in C2 stripper, which is equipped with 40 trays. The heat of stripping is supplied by TCO PA stream in C2 stripper re-boiler (E-12). The C2 stripper overhead vapors leave from the top of tower and join at the discharge of the wet gas compressor second stage. The stripper bottom stream flows by differential pressure between stripper (C-05) and debutanizer (C-06) on flow control reset by stripper bottom level to the debutanizer tower. The debutanizer is a 40-trays (valve trays) tower designed to produce a totally condensed overhead mixed LPG product and a bottom C5+ product. C2 stripper bottom stream is heated by E-11A against debutanizer bottom stream. After heating, it enters on tray no. 20 of C-06. Provision has been given to put it at tray no. 22 also. The overhead vapors are cooled to 40oC in the stabilizer condenser (E-14) and sent to Stabilizer reflux drum (V-06). A part of this LPG is pumped back by stabilizer reflux pump (P-14 A/B) to C-06 top as a reflux and other part is drawn as product and sent for further separation / treatment section. The bottom liquid from C-06 is a stabilized gasoline, which is cooled to 40oC in the stabilizer bottom cooler (E-11). A part of this liquid is pumped back to C-03 by Stabilizer bottom pump (P-16 A/B), while the other part is drawn as product and sent for further separation / treatment section.

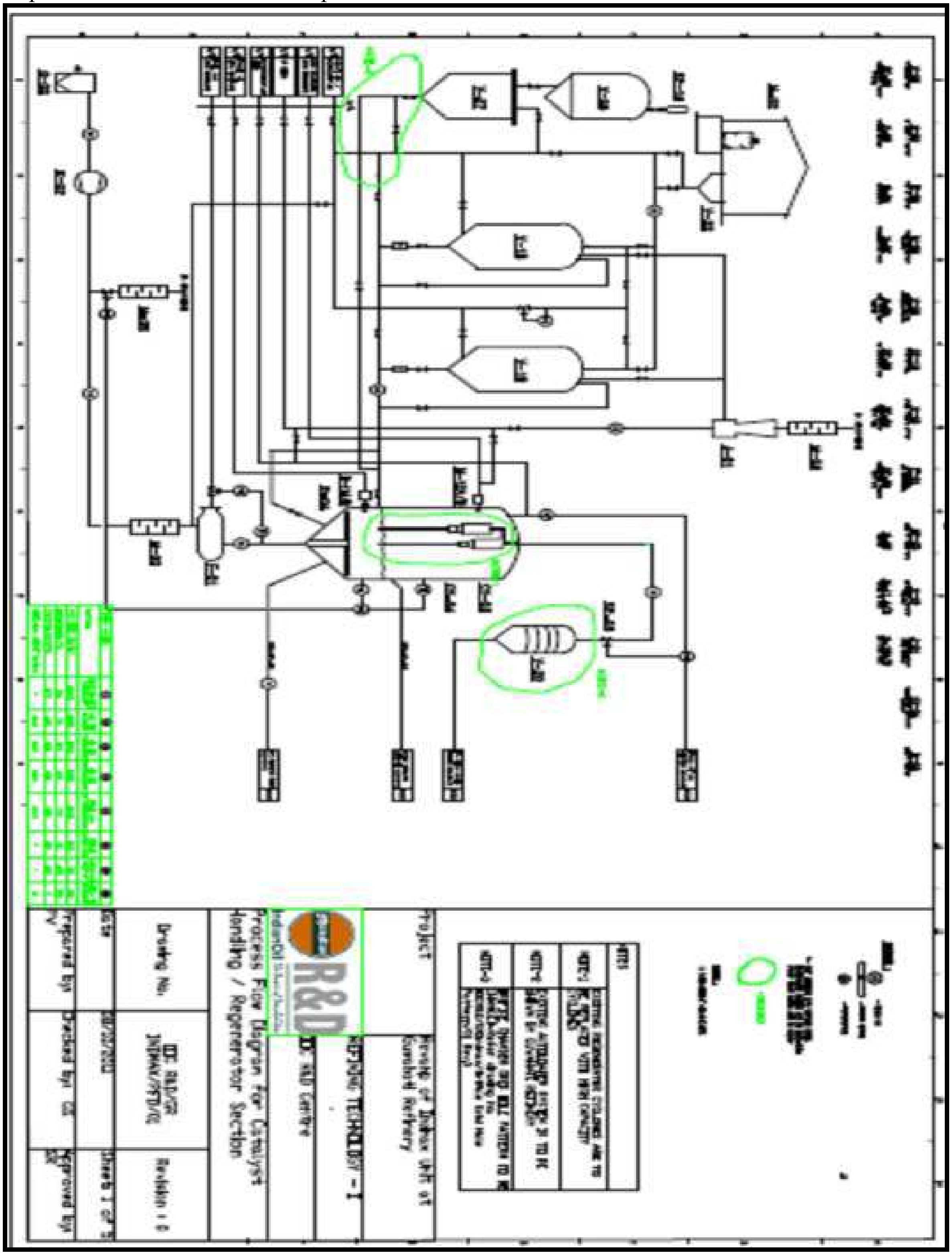


Figure 1: PFD for Catalyst Handling / Regeneration Section

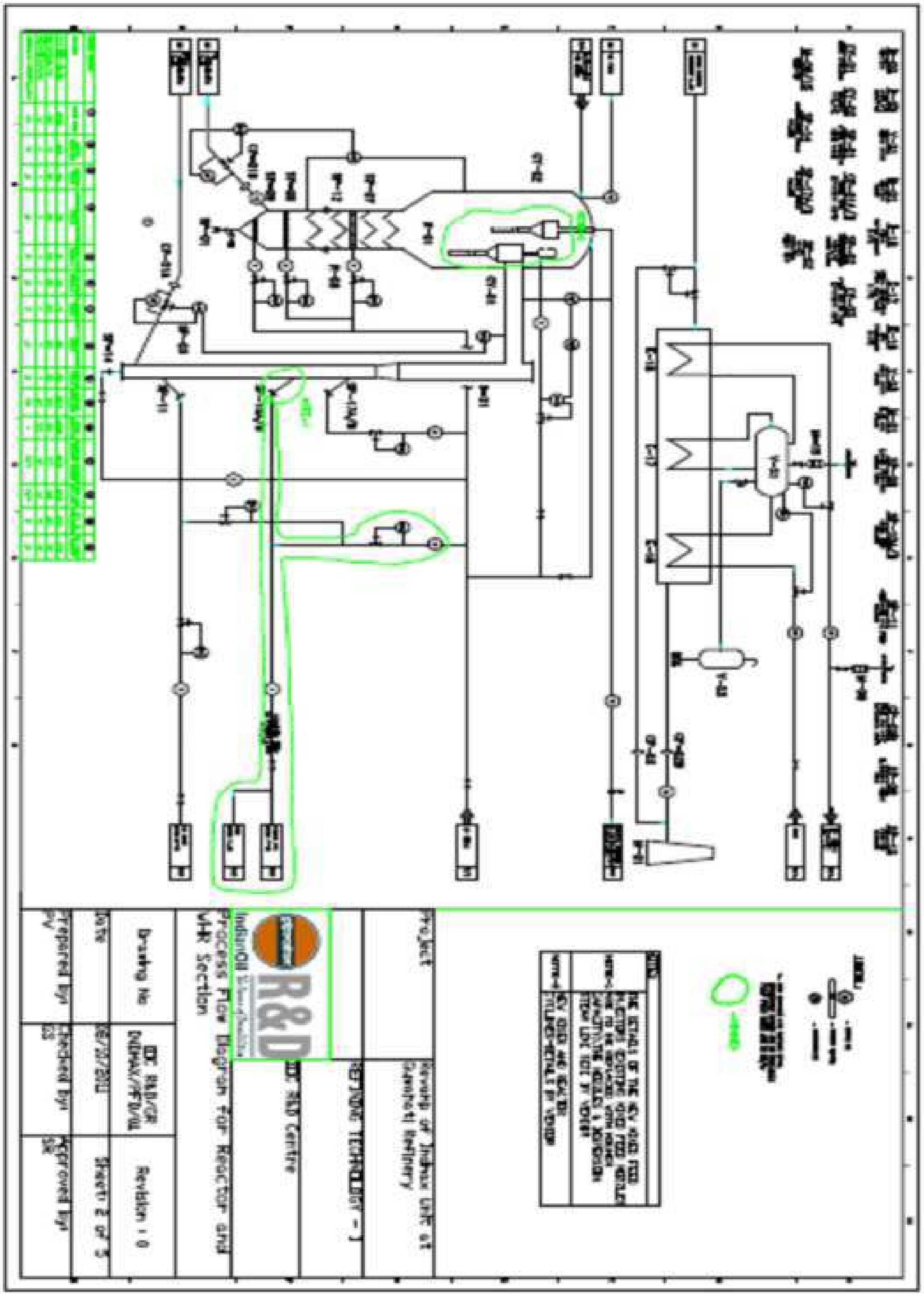


Figure 2: PFD for Reactor and WHR Section

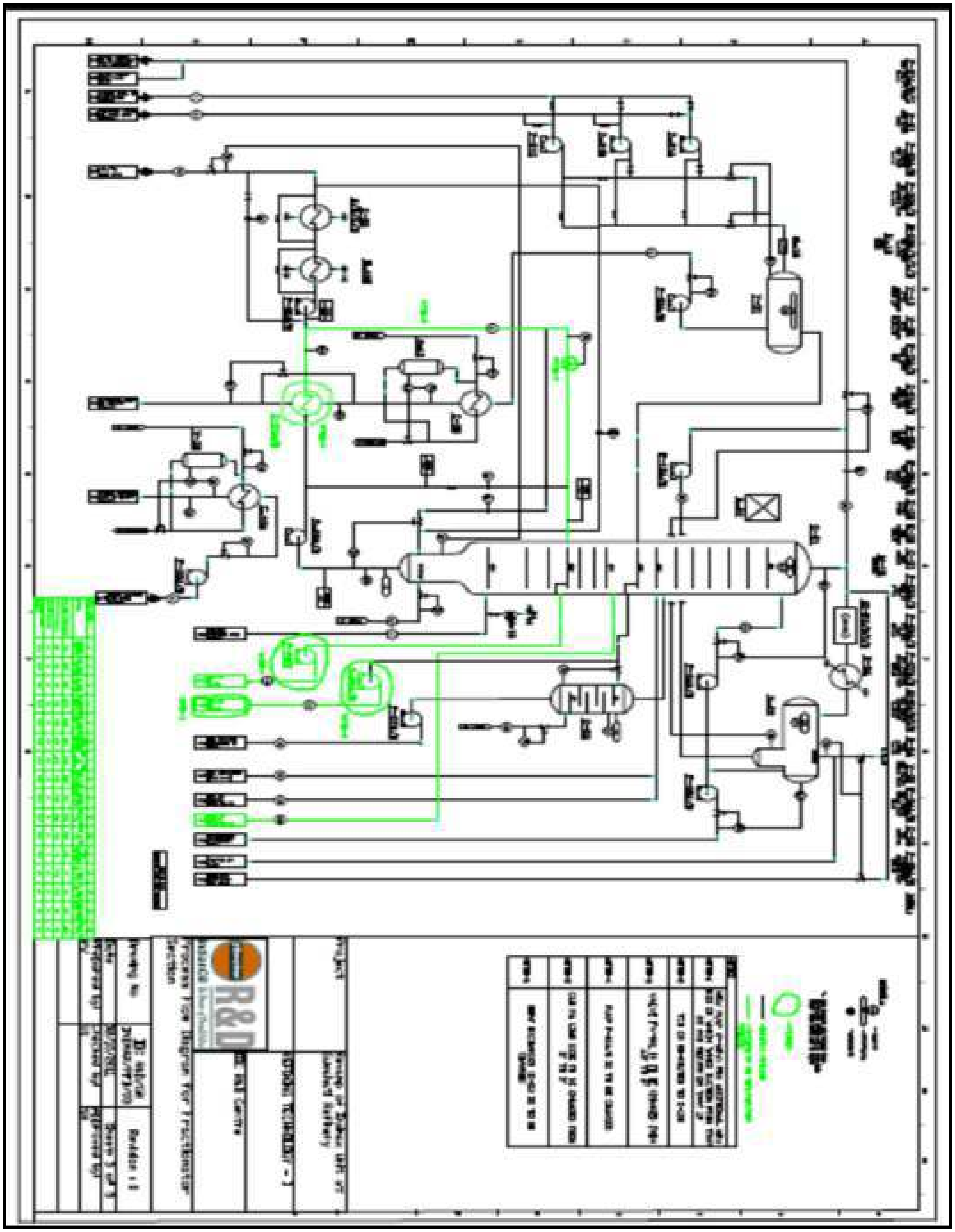


Figure 3: PFD for Fractionator Sector

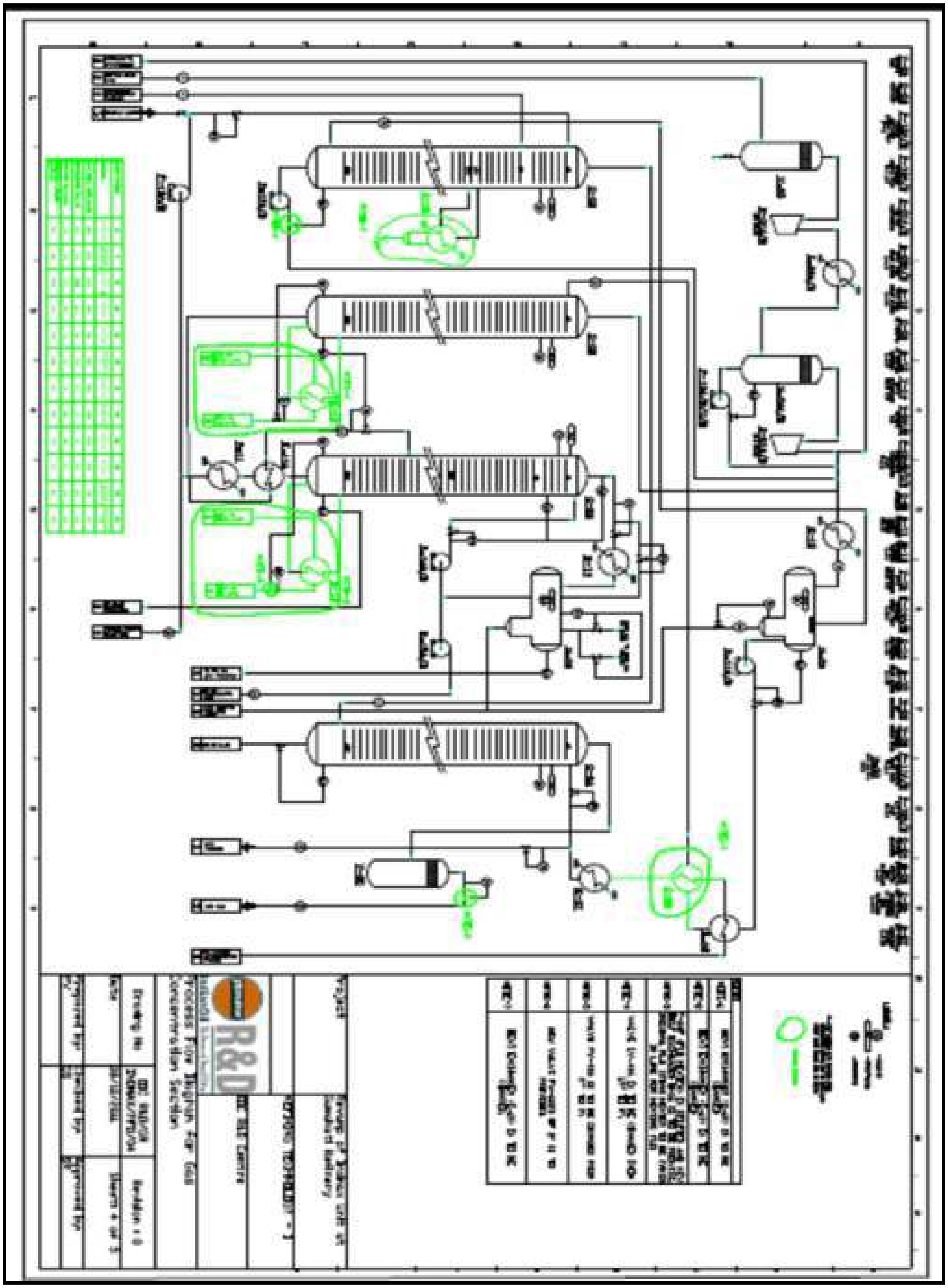


Figure 4: PFD for Gas Concentration Section

2.9 Sulphur Balance of the Refinery

Sulphur balance of the refinery in the current scenario is given in **Table** 9

Table 9: Sulphur Balance

		Qty. MT	% WT	PPM of S	MT of S
A. INPUT					
	Crude intake	1000000	100.0	2052	2052
	Total Intake	1000000	100.0		
B. OUTPUT					
1. Finished products :	LPG	51889	5.2	80	4.2
	SRN	15000	1.5	100	2
	MRN	-3	0.0	1250	0.0
	MS BS-III	169138	16.9	140	23.7
	Less LN import	0	0.0	0	0.0
	Less Mktg.MS ex-BR/BGR	0	0.0	-1250	0.0
	Less Reformate_JR blended in MS	-70000	-7.0	-25	1.8
	Less Reformate_MR blended in MS	0	0.0	-25	0.0
	Less Reformate_BR blended in MS	0	0.0	0	0.0
	Less NRS_PR blended in MS	0	0.0	-25	0.0
	Less Reformate_AOD blended in MS	-9000	-0.9	-25	0.2
	Total light distillate	**157024**	**15.7**		**27.2**
	ATF	60000	6.0	150	9.0
	SKO	0	0.0	500	0.0
	HSD-BS-III	614961	61.5	300	184.5
	LDO	0	0.0	4500	0.0
	Less SKO ex. BR	0	0.0	-300	0.0
	Less SKO ex. JR	0	0.0	-200	0.0
	Less SKO ex. PR	0	0.0	-200	0.0
	Less SKO ex. BGR	0	0.0	-300	0.0
	Less IND SKO ex. PR	0	0.0	-850	0.0
	Less BRPL NAD	0	0.0	-1500	0.0
	Total middle distillate	**674961**	**67.5**		**193.5**
	CLO	0	0.0	7500	0.0
	Sulphur	760	0.1		760.0
	RPC	58460	5.8	12500	730.7
	Total heavy ends	**59220**	**5.9**		**1490.7**
Total Finished products		891205	89.1		**1711.4**
2. ISD		0	0.0	5400	0.0
3. Product Recovery :		891205	89.1		**1711.4**

4. Own fuel :	Oil			70576	7.1	4700	331.7
	Gas			37672	3.8	150	5.7
	Total fuel			**109684**	**11.0**		337.4
5. Loss :	Liq. loss			2000	0.2	4700	9.4
	Flare loss			1500	0.2	150	0.2
	Total loss			**3500**	**0.4**		**9.6**
6. Fuel & Loss				113184	11.3		**347.0**
7. # Imports consumption:							
	Foots oil ex AOD			4389	0.4	-1600	7.0
	LVFO ex. AOD			0	0.0		0.0
	LSHS ex- BRPL			0	0.0		0.0
	Total Imports consumption.			**4389**	**0.4**		**7.0**
Grand total				**1000000**	**100.0**		

2.10 Water Demand

Make-up water requirement of the existing units and facilities is 455 m^3/hour. To meet this requirement, 290 m^3/hour is drawn from River Brahmaputra, and the balance 165 m^3/hour is met through recycle of treated effluents. The proposed revamp of INDMAX Unit will increase the water requirement by 1 m^3/hour, which will be met from treated effluents. Thus, no additional fresh water will be required for the proposed revamp.

Raw water from the river Brahmaputra is pumped into the Clarifloculators of Water Treatment Plant (WTP) where alum treatment is carried out for removal of suspended solids. Clarified water from the clarifloculators is stored in Industrial reservoir from where the same is supplied to the Refinery. WTP of Guwahati Refinery is located on top of the hill south of Refinery's housing colony, Sector-1 and is about 3 km from the Refinery. The plant was installed for supplying industrial water to Refinery and drinking water for the Refinery Township and some other nearby establishments including MES at Narengi.

The water requirement of the Refinery in 2013-14 was as follows in **Table-10**;

Table 10 : Fresh Water System

Industrial water pumped (all figures. In cu.m)	
	2013-14
Water pumped into WTP	11163944
Water flow out with sludge	223278
Clarified water supplied from WTP	10940666
Filtered water supplied	8246762
Clarified water supplied to refinery	2693904
Break-up of filtered water supplied (all figures. In cu.m)	
MES	3262329

Community development	1838504
Choonsali tea estate	-
Industrial estate	-
Vandana cinema	-
ASEB	0
India corbon limited	48458
IOCL (marketing division)	9793
Refinery colony	2851964
Others	235018
SBI, Noonmati / RBI	969
TOTAL	8246762

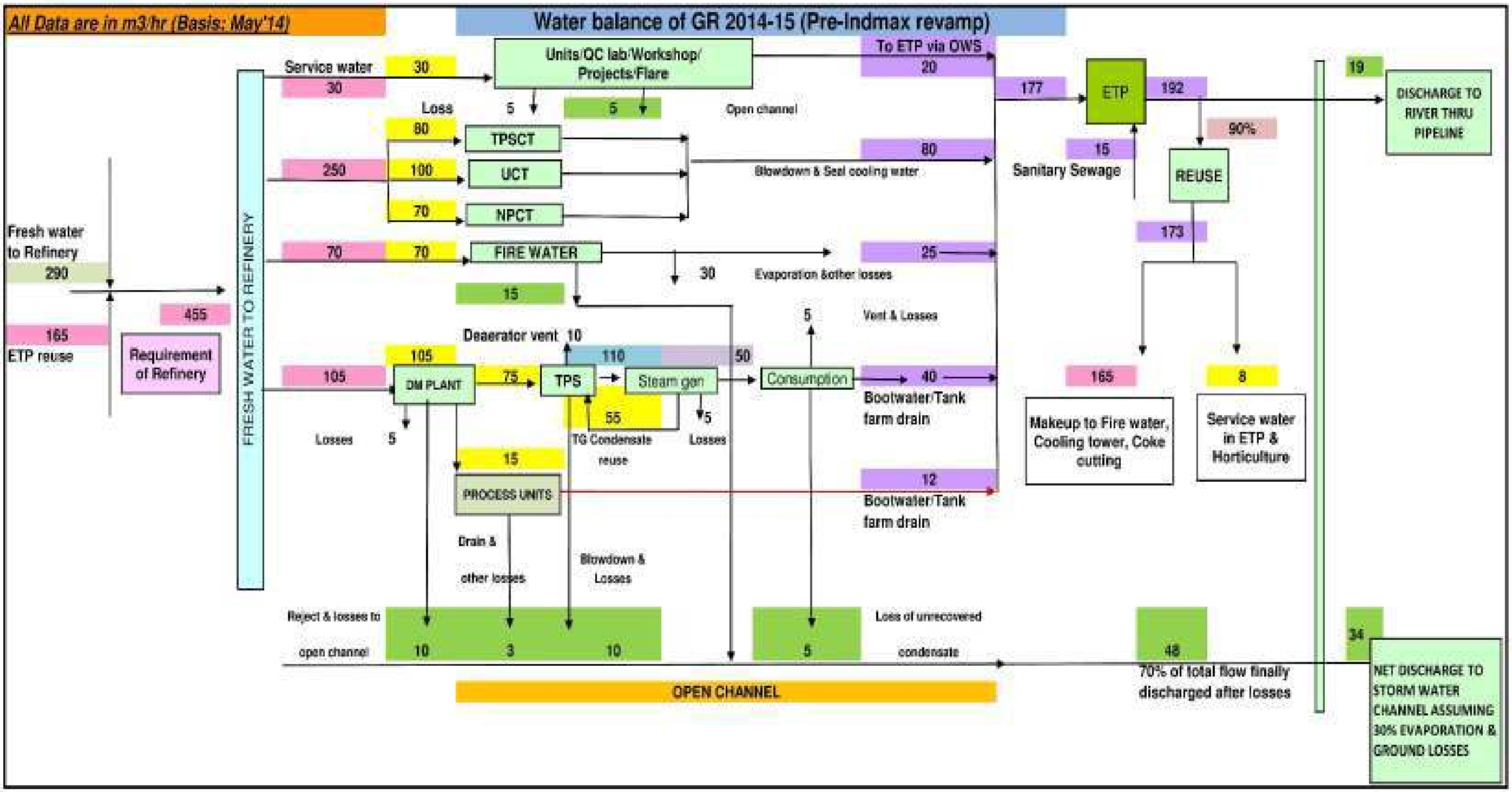


Figure 5 : Water Balance Pre Indmax-revamp

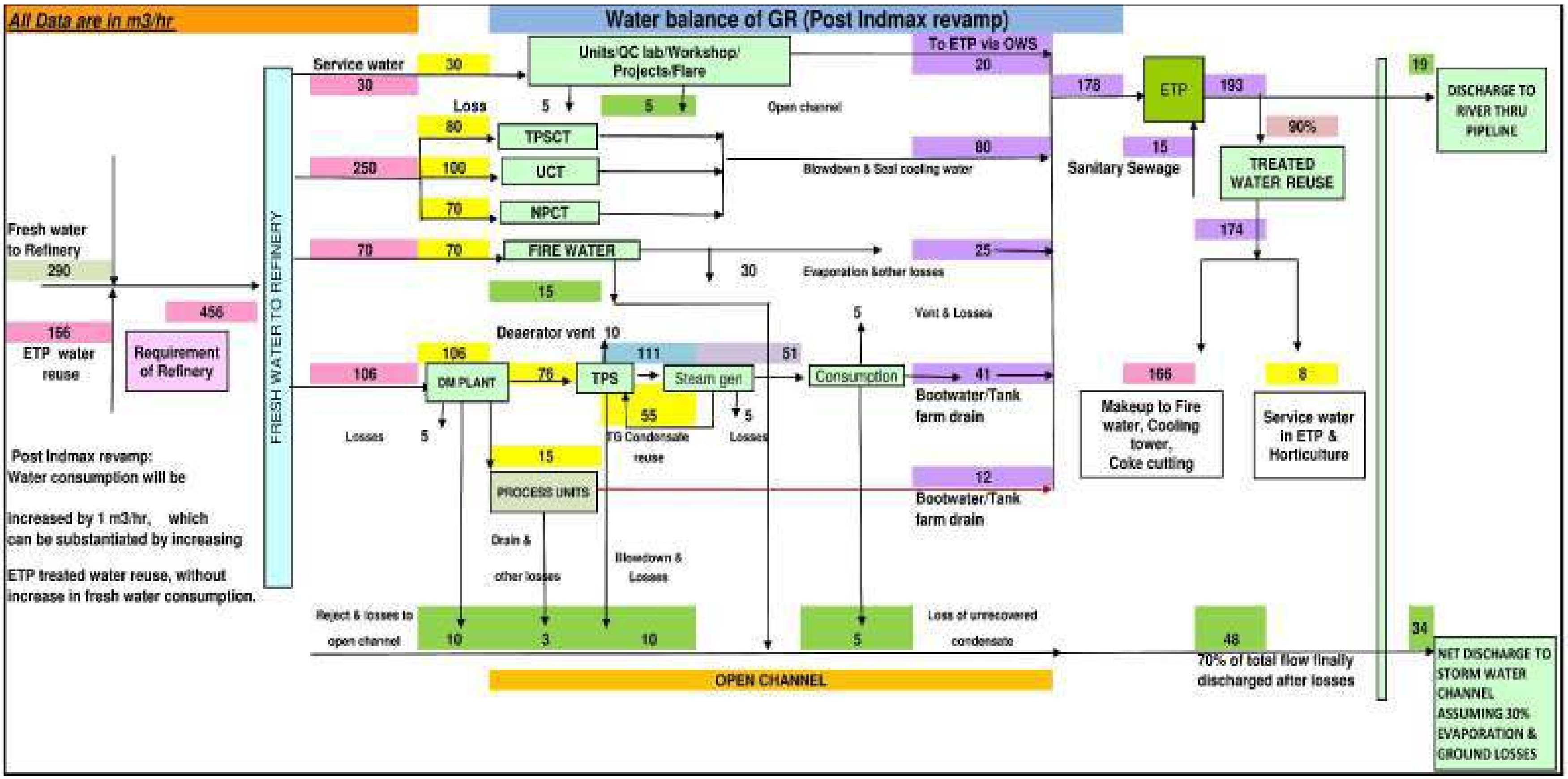


Figure 6: Water Balance Post Indmax-revamp

2.11 Effluent from INDMAX Unit after Revamp

<table>
<tr><th>Effluent Type</th><th>Details</th></tr>
<tr><td>Solid</td><td>A total of 59.4 Tons (maximum) per Annum of e-cat (Equilibrium Catalyst) will be withdrawn from the unit.
The catalyst withdrawn will be stored in the refinery and used as e-cat as and when required in the unit.</td></tr>
<tr><td>Liquid</td><td>Increase in quantity of Sour Water will be 0.2 m^3/hr. Total Sour Water quantity will be 3.5 m^3/hr.
Sour Water with ~2.0 ppmv H_2S concentration will be treated in Sour Water Stripper.</td></tr>
<tr><td>Gaseous</td><td>Gaseous effluent from the unit is the flue gas generated in the Regenerator section.
Details of flue gas are given in the following table:
<table>
<tr><th>Component</th><th>Units</th><th>Revamp Case</th></tr>
<tr><td>SPM</td><td>mg/Nm³</td><td>< 57</td></tr>
<tr><td>SOx</td><td>mg/Nm³</td><td>144</td></tr>
<tr><td>NOx</td><td>mg/Nm³</td><td>125</td></tr>
<tr><td>CO</td><td>ppmv</td><td>7.5</td></tr>
<tr><td>Opacity</td><td>%</td><td>25</td></tr>
</table></td></tr>
</table>

2.12 Description of Mitigation Measures

Detail description of mitigation measures given in **Chapter 4.**

2.13 Assessment of New & Untested Technology for the Risk of Technology Failure

No new technology implemented in the INDMAX Revamp, hence there is no requirement of assessment of new technology for the risk of technology failure.

2.14 Effluent Treatment Plant

2.14.1 The Plant

Additional Sour water of around 0.2 m^3/hr will be generated from the Unit which is marginal and will be taken care in the existing effluent treatment facilities at Guwahati Refinery.

The Effluent Treatment Plant (ETP) of Guwahati Refinery is in operation since inception of the refinery, which was commissioned in the year 1962. Initially, ETP was having API separator along with aeration facility and the treated effluent was meeting the then standards. The ETP was modernized in the year 1976-77 with the addition of Chemical and Biological Treatment facilities, to meet MINAS (Minimal National Standards) norm. The ETP had two channels of capacity 800 m^3/h each.

The ETP was modernized again in the year 2006-07 with the latest technologies by addition of

(i) Two Equalization tanks to regulate flow rate and to stabilize pollutant loads for enhancing effective treatment of wastewater,

(ii) TPI (Tilted Plate Interceptor) unit for removal of free oil and suspended solids,

(iii) DAF (Dissolved Air Floatation) unit for removal of emulsified oil and suspended solids,

(iv) Aeration Tanks for growing of micro-organisms that metabolize their own protoplasm without replacement since the concentration of food available is at a minimum and to generate less solid-waste,

(v) Two Centrifuge (Sludge De-watering) Systems for removing of oil from accumulated sludge to less than 10% and

(vi) The latest filtering system i.e., PSF (Pressure Sand Filter) and ACF (Activated Carbon Filter) for removal of turbidity.

2.14.2 Capacity of New Effluent Treatment Plant

Design flow: Wet weather flow (WWF): 550 m^3/h
Dry Weather Flow (DWF): 365 m^3/h

2.14.3 Influent Characteristics (2012-13)

Table 11: Influent Characteristics (2012-13)

Parameters	DWF Max	WWF Max
pH	6.5 – 9. 0	6.5 – 9.0
Total Oil (mg/L)	3930	1965.0
TSS (mg/L)	200	100.0
BOD (mg/L)	120	60.0
COD (mg/L)	290	145.0
Sulfides (mg/L)	11	5.5
Phenol (mg/L)	15	7.5
Ammonia (mg/L)	30	15.0

2.14.4 Treated Effluent Characteristics (2012-13)

pH	6.5 – 8.5
Oil	< 5.00 ppm
Sulfide	< 0.25 ppm
Phenol	< 0.35 ppm
TSS	< 10.0 ppm
BOD	< 7.50 ppm

A schematic diagram of the ETP is shown in Figure-7

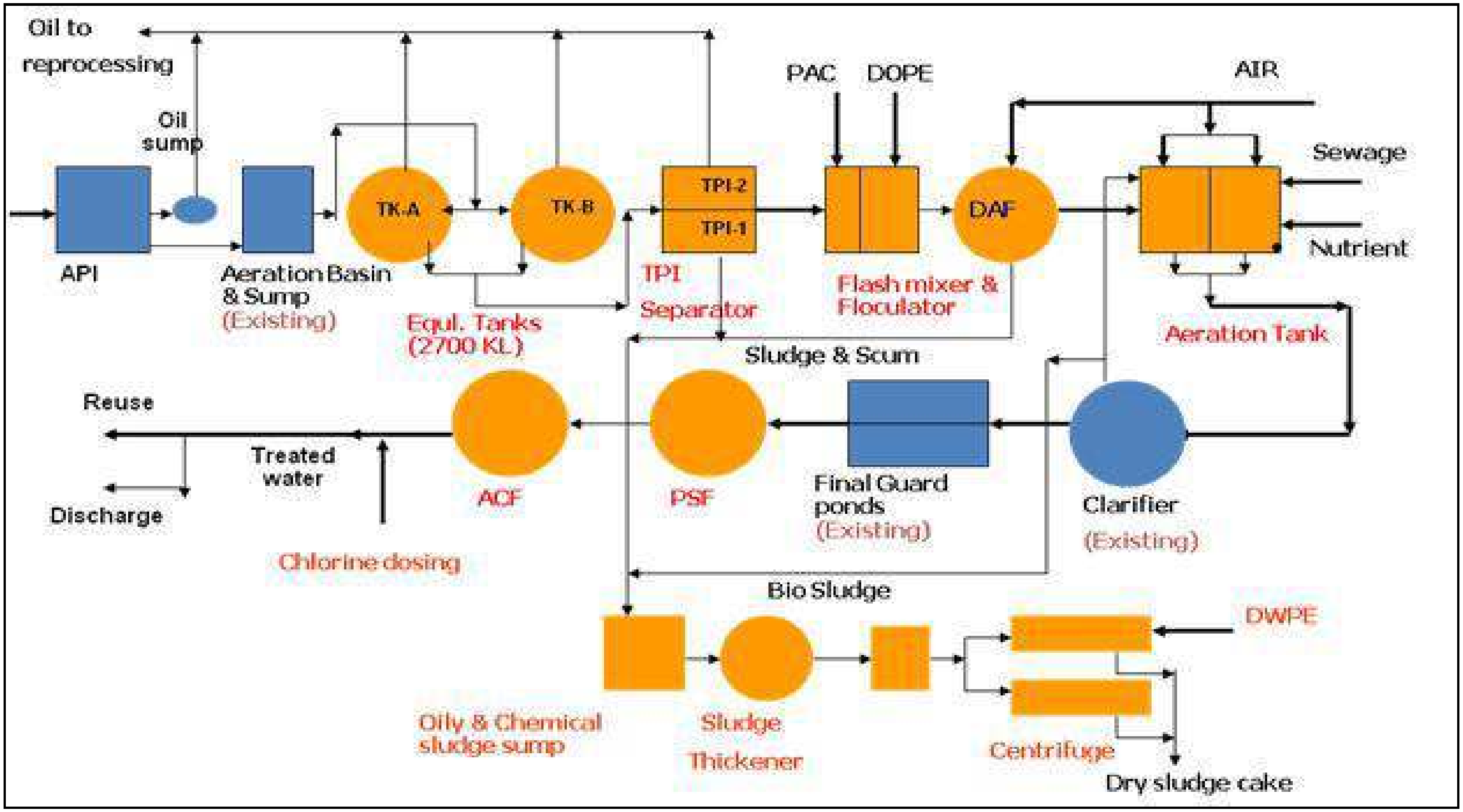


Figure 7: Effluent Treatment Plant

The Effluent Treatment Plant consists of Physical Treatment Section, Chemical Treatment Section, Biological Treatment Section and Polishing section.

The treated effluent is reused for coke cutting and pressurizing the fire water network. The excess treated water is routed to Treated water sump, from which it is pumped to River Brahmaputra through a 26 KM long underground pipeline. This is discharged near Saraighat Bridge at the downstream of Guwahati city.

2.14.5 Volume of Effluent treated at the ETP

The volume of effluent treated by the Refinery in its Effluent Treatment Plant (ETP) during 2012-13 was shown below in **Table 12**.

Table 12: Volume of Effluent Treated during 2012-13

Effluent treatment plant performance	2012-13	Percentage (%)
Effluent treated (m^3)	1888220	--
Effluent discharged (m^3)	318238	16.8
Effluent reused (m^3)	1569982	83.2

As much as 83.2 % of the treated effluent is reused in the system with only 16.8 % being discharged from the ETP.

2.14.6 Quality of the Treated Effluent

The quality of the treated effluent with respect to important parameters is summarized in **Table-13**.

Table 13: Quality of Treated Effluent (2012-13)

S/N	Parameter	Concentration (mg/L except pH)	
		National Limit	Observed average (2012-13)
1	pH	6.0 – 8.5	6.9 – 7.2
2	Oil & Grease	5.0	2.2
3	BOD	15	6.6
4	COD	125	31.4
5	Suspended Solids	20.0	15.0
6	Phenols	0.35	0.10
7	Sulphides	0.5	0.01
8	CN	0.2	0.01
9	Ammonia as N	15.0	0.10
10	TKN	40.0	0.34
11	P	3.0	0.20
12	Cr (VI)	0.1	0.08
13	Cr (Total)	2.0	0.11
14	Pb	0.1	0.01

15	Hg	0.01	0.01
16	Zn	5.0	0.03
17	Ni	1.0	0.01
18	Cu	1.0	0.04
19	V	0.2	0.20
20	Benzene	0.1	0.05
21	Benzo(a)pyrene	0.2	0.01
Effluent discharge, m^3/month			**26520**
Crude MT/month			**79704**

2.14.7 Performance Categorization

A comparison of the prescribed National limits and the average performance of the Refinery with respect to quantum values, presented below, shows consistently good performance in given in **Table 14**;.

Table 14: Performance of ETP Refinery (2012-13)

S/N	Parameter	Quantum value (kg/TMT of Crude processed)	
		National Limit	Average (2012-13)
1	pH	--	
2	Oil & Grease	2	0.78
3	BOD	6	2.1
4	COD	50	9.7
5	Suspended Solids	8	4.3
6	Phenols	0.14	0.03
7	Sulphides	0.2	0.00
8	CN	0.08	0.00
9	Ammonia as N	6	0.03
10	TKN	16	0.09
11	P	1.2	0.05
12	Cr (VI)	0.04	0.02
13	Cr (Total)	0.8	0.03
14	Pb	0.04	0.00
15	Hg	0.004	0.00
16	Zn	2	0.01
17	Ni	0.4	0.00
18	Cu	0.4	0.01
19	V	0.8	0.05
20	Benzene	0.04	0.01
21	Benzo(a)pyrene	0.08	0.00
Effluent discharge, m^3/TMT of crude processed		400/700	272

2.14.8 Reduction in Treated Effluent Discharge

Reduction in discharge is achieved by reusing the treated effluent as Coke cutting water, makeup for fire water and make up to cooling tower. In addition to this, treated effluent is reused for gardening.

CHAPTER-3:
DESCRIPTION OF THE ENVIRONMENT

CHAPTER-3 : DESCRIPTION OF THE ENVIRONMENT

To assess the impact from the proposed project unit and its management, it is important to determine the baseline status of the environment in the area of influence. The aspects considered and covered under the study are topography, physiography, water environment, climate & meteorology, air environment, meteorology, biological environment, noise, soil, land use and socio-economic environment. This chapter provides the description of the studies and findings during the baseline studies in the area of influence.

3.1 Study Period

As per the statutory requirements, the baseline environmental status needs to be established through study during one full non-monsoon season. Accordingly, monitoring and field studies for establishing the baseline environmental status were carried out during pre-monsoon (summer) season of 2014, starting from 02nd April 2014 and continued up to 30th June 2014.

3.2 Study Area

The area of influence for the environmental impact assessment was considered as the area falling within 10 KM radius from the project site. Thus the study area considered for determining the baseline environmental status is the area falling within 10 KM radius from the project site. Geographically, the project site is located at latitude 26°11'05.93" N and longitude 91°48'36.04'' E. The study area for the EIA study is covered and is spread around Noonmati Village in Guwahati District of Assam. The map showing the study area is given in Annexure-III. The various monitoring locations for sampling and monitoring are shown in Figure 8.

3.3 Components of Baseline Environment Data

Baseline environmental components are given below:

- Air Environment
- Water environment
- Noise environment
- Socio-Economic Environment
- Biological Environment
- Land Use and Land Cover

3.4 Basemaps of All Environmental Components

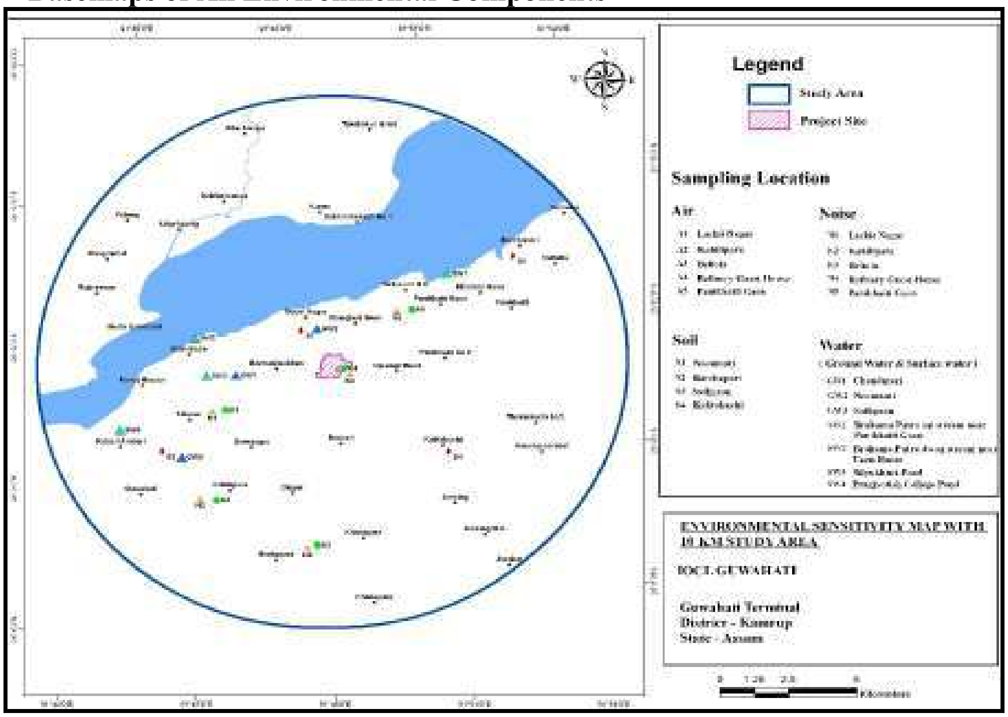


Figure 8: Sampling Location Map

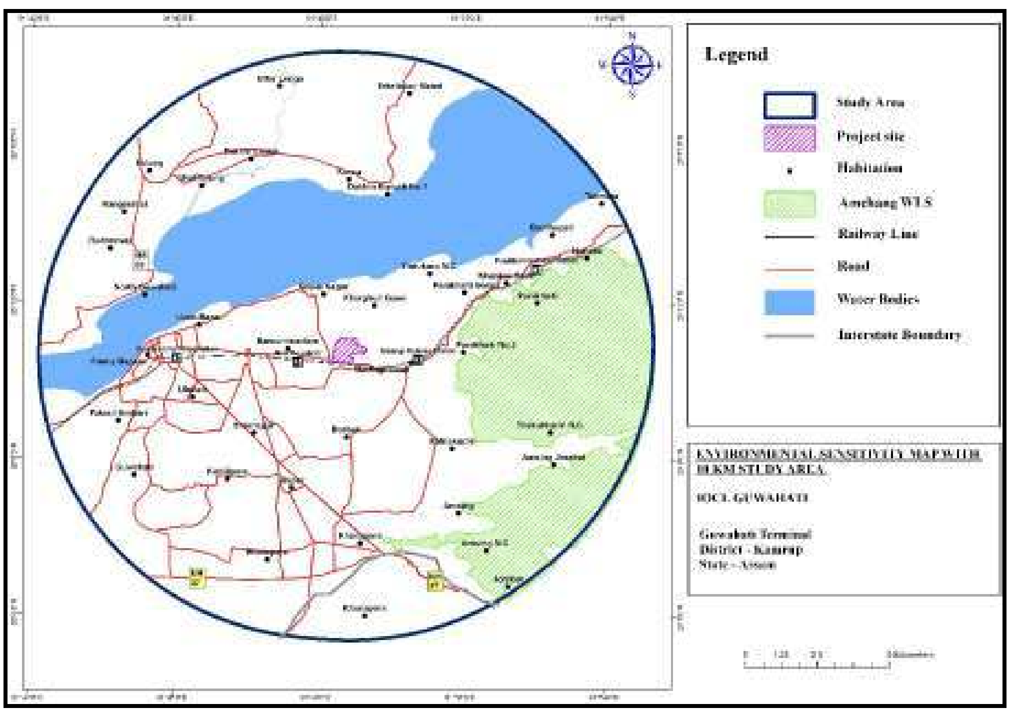


Figure 9 : Environment Sensitivity Map

3.5 Climate and Meteorology

The climate of the study area is generally humid and tropical. A hot and humid pre-monsoon from March to May, a prolonged southwest monsoon or rainy season from June to September, a pleasant post-monsoon or retreating monsoon from October to November and a cold pleasant winter from December to February are the typical characteristics of the general climate. Summer runs concurrently with the later part of the pre-monsoon season and continues throughout the monsoon season.

Guwahati's climate is generally described as temperate. The city's average yearly temperature is recorded at 24 degree Celsius (76 °F). Average high temperature is recorded at 29 degree Celsius (85 °F), while the average low at 19 degree Celsius (67 °F). The highest recorded yearly temperature is 40 degree Celsius (104 °F), while the lowest recorded yearly temperature is 5 degree Celsius (41 °F). December, January and February are the coldest and June, July, August and September are the hottest. Average yearly precipitation is 161.3 cm (63.5 inches) with an average number of 77.3 rainy days. June and July are the wettest months. Extreme high level of humidity, many a times at more than 80/90 percent often creates discomfort during summer. A 30 year meteorological data is attached as **Figure-11 (a & b)**

3.6 Meteorological Condition during Study Period

The prominent wind direction in the study area during the monitoring season is found to be North-East (**Fig-10**) and the average wind speed is 1.08 m/s. The prevalent wind speed characteristic is said to be calm as the calm percentage is 34.71 %.

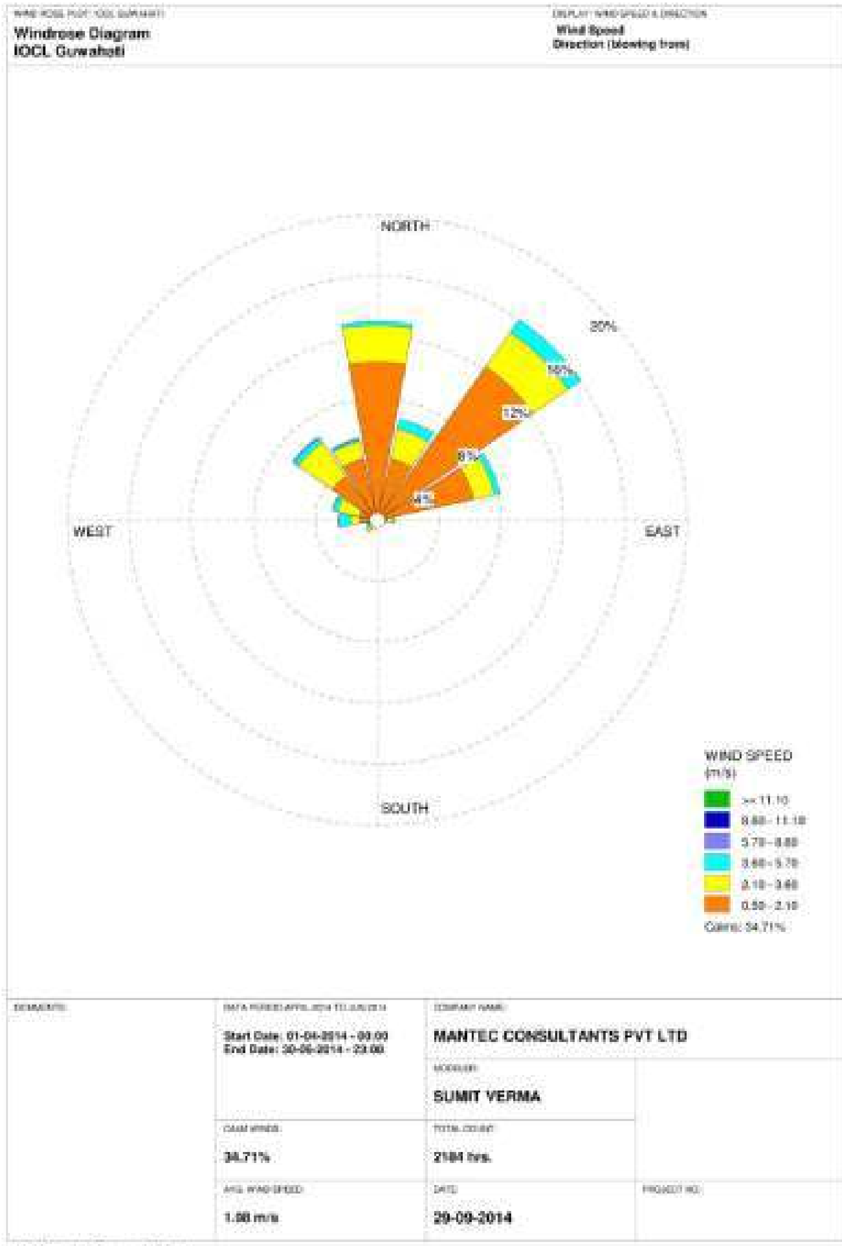


Figure 10: Windrose Diagram of the Project

CLIMATOLOGICAL TABLE (30 Years meteorological Data: Year 1951 to 1980)
Station: Guwahati (Bhorjar) LAT: $25^0 06^{/}$ N; LONG: $91^0 35^{/}$ E

AIR TEMPERATURE														
			MEAN						EXTREMES				HUMIDITY	
MONTH		STATION LEVEL PRESSURE	DRY BULB	WET BULB	DAILY MAX	DAILY MIN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	HIGHEST	DATE & YEAR	LOWEST	DATE & YEAR	RELATIVE HUMIDITY	VAPOUR PRESSURE
		MPa	^{0}C	^{0}C	^{0}C	^{0}C	^{0}C	^{0}C	^{0}C		^{0}C		%	hPa
JAN	I	1011.5	15.4	14.0	23.6	9.8	26.0	6.8	28.4	07	3.0	30	86	15.0
	II	1007.3	18.7	15.8						1958		1964	72	15.6
FEB	I	1008.9	18.0	15.2	26.4	11.5	30.4	7.6	32.4	21	5.3	04	73	15.1
	II	1004.5	22.5	16.9						1976		1968	55	14.7
MAR	I	1006.3	22.4	18.1	30.2	15.5	35.2	11.2	38.6	27	8.5	11	65	17.3
	II	1001.5	26.8	19.3						1979		1979	48	16.3
APR	I	1003.5	25.4	21.5	31.5	20.0	36.3	15.9	39.5	30	10.3	01	71	22.6
	II	998.7	28.6	22.4						1960		1968	58	22.1
MAY	I	1000.3	26.5	23.8	31.0	22.5	35.5	19.1	40.3	01	16.4	03	79	27.2
	II	995.8	28.9	24.7						1960		1975	71	27.6
JUN	I	996.4	27.8	25.7	31.4	24.7	34.9	22.2	38.5	06	20.6	01	84	31.3
	II	992.8	29.0	26.2						1979		1979	79	31.6
JUL	I	996.0	28.4	26.3	31.8	25.5	34.7	23.7	36.7	10	21.6	08	85	32.6
	II	993.7	29.4	26.7						1979		1978	80	32.8
AUG	I	997.3	28.6	26.4	32.1	25.5	34.8	23.5	36.3	25	22.3	21	84	32.7
	II	993.6	29.2	26.6						1973		1978	81	32.6
SEP	I	1001.1	28.2	25.9	31.7	24.6	34.5	22.6	35.9	05	21.2	08	83	31.6
	II	997.2	28.3	25.9						1957		1959	82	31.4
OCT	I	1006.1	26.0	23.8	30.1	21.8	32.9	18.2	34.5	01	13.8	31	83	27.7
	II	1002.1	26.6	24.3						1980		1979	82	28.6
NOV	I	1009.8	21.5	19.7	27.4	16.4	29.9	12.6	32.5	03	10.0	22	84	21.6
	II	1005.9	22.6	20.5						1957		1965	82	22.6
DEC	I	1011.6	17.1	15.7	24.6	11.5	27.0	8.5	30.9	18	4.9	28	87	16.9
	II	1007.6	19.1	17.1						1957		1961	80	17.9
ANNUAL TOTAL OR MEAN		1004.1	23.8	21.3	29.3	19.1	37.0	6.5	40.3		3.0		80	24.3
		1000.0	25.8	22.2									73	24.5

I-0830 Hours I.S.T. ; II – 1730 Hours I.S.T

CLIMATOLOGICAL TABLE (30 Years meteorological Data: Year 1951 to 1980)
Station: Guwahati (Bhorjar) LAT: $25^{0}06^{\prime}$ N; LONG: $91^{0}35^{\prime}$E

MONTH		STATION LEVEL PRESSURE	RAIN FALL						CLOUD AMOUNT		MEAN WIND SPEED
			MONTHLY TOTAL	No. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR	TOTAL IN DRIEST MONTH WITH YEAR	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	ALL CLOUDS	LOW CLOUDS	
		MPa	mm		mm	mm	mm		Oktas of Sky		Km/hr.
JAN	I	1011.5	11.4	1.2	65.7	0.0	39.1	10	2.2	1.0	2.5
	II	1007.3			1957			1957	2.8	0.9	
FEB	I	1008.9	12.8	1.3	46.6	0.0	34.0	24	1.9	0.8	3.7
	II	1004.5			1980			1980	2.8	1.2	
MAR	I	1006.3	57.7	4.6	176.1	4.6	49.8	22	2.4	0.9	5.1
	II	1001.5			1953	1957		1955	3.2	1.4	
APR	I	1003.5	142.3	9.0	413.3	34.1	100.3	30	3.7	2.0	8.3
	II	998.7			1977	1960		1955	3.9	2.1	
MAY	I	1000.3	248.0	14.3	424.6	62.6	96.8	12	5.6	3.3	5.7
	II	995.8			1952	1969		1958	4.5	2.6	
JUN	I	996.4	350.1	16.1	593.7	122.4	194.3	05	6.6	4.0	4.6
	II	992.8			1956	1967		1956	6.2	3.4	
JUL	I	996.0	353.6	16.8	646.7	180.7	131.6	12	7.0	4.3	4.3
	II	993.7			1977	1962		1970	6.4	3.7	
AUG	I	997.3	269.9	13.9	393.9	70.6	129.2	29	6.7	3.8	4.2
	II	993.6			1950	1979		1960	6.2	3.6	
SEP	I	1001.1	166.2	10.3	405.2	27.2	90.2	16	5.9	3.4	3.7
	II	997.2			1953	1962		1966	5.9	3.3	
OCT	I	1006.1	79.2	5.3	261.4	20.2	60.9	01	4.5	2.9	3.4
	II	1002.1			1651	1967		1974	4.2	2.4	
NOV	I	1009.8	19.4	1.5	81.5	0.0	38.5	23	3.3	2.1	2.9
	II	1005.9			1971			1966	3.0	1.5	
DEC	I	1011.6	5.1	0.4	36.6	0.0	35.3	10	2.5	1.3	2.3
	II	1007.6			1973			1973	2.7	0.9	
ANNUAL TOTAL OR MEAN		1004.1	1717.7	94.7	2476.6	1452.2	194.3		4.4	2.5	4.1
		1000.0			1977	1975			4.3	2.3	
I-0830 Hours I.S.T. ; II – 1730 Hours I.S.T											

Source: (adopted from www.iitg.ac.in/ceer/matdata.pdf)

Figure 11 (a & b): Meteorological Data of Guwahati Area

3.7 Land Environment

The project is located in Guwahati district in Noonmati village. A total 490 acre of land has been used for the IOCL Guwahati refinery. As the proposed project is to revamp the existing unit, it does not need additional land requirement. A detailed land break-up of the area used by IOCL Guwahati is given in **Table-15**.

Table 15: Land Break-up of the Refinery

Unit	Land Requirement
Plant area	132 Acre
Sector-I	120 Acre
Sector-II	100 Acre
Sector-III	108 Acre
Misc. Area	30 Acre
Total Area	**490 Acre**

A 10 km study area is 350.98 km As the proposed project is located in the Noonmati village, majority of the study area lies in the human settlement. The landuse/landcover of the project area is given in **Table 16** and in **Fig 12**.

3.7.1 Landuse and Landcover of the study area

The objectives of land use/ Land cover studies are:

- To determine the present land use pattern;
- To ascertain the temporal changes in land use pattern due to construction and operation phase.

3.7.2 Methodology

Satellite data: - The land use of the study area is studied and analyzed by using the latest available satellite imagery.

3.7.3 Land use /Land Cover Map

The study area of 10-km around the plant boundary is considered in the land use pattern study. The study area theoretically covers an area of 350.98 sq km within the circle encompassed by 10-km radius around the project site.

For computation of the land use pattern in the study area Arc GIS software are used. The geographical area of all settlements covered within the study area is considered. The land use is classified into 6 classes - viz. Agricultural land, Settlement, Forest land, Waste land,Sandy land and Water bodies.

Table 16: LULC of the Project Area

S.No	Classes	Area (sq.km)	Area in %
1	Agriculture	32.45	9.25
2	Settlement	132.75	37.82
3	Forest Land	82.98	23.64
4	Waste Land	2.12	0.60
5	Sandy Land	34.34	9.78
6	Water Bodies	66.34	18.90
Total		**350.98**	**100.00**

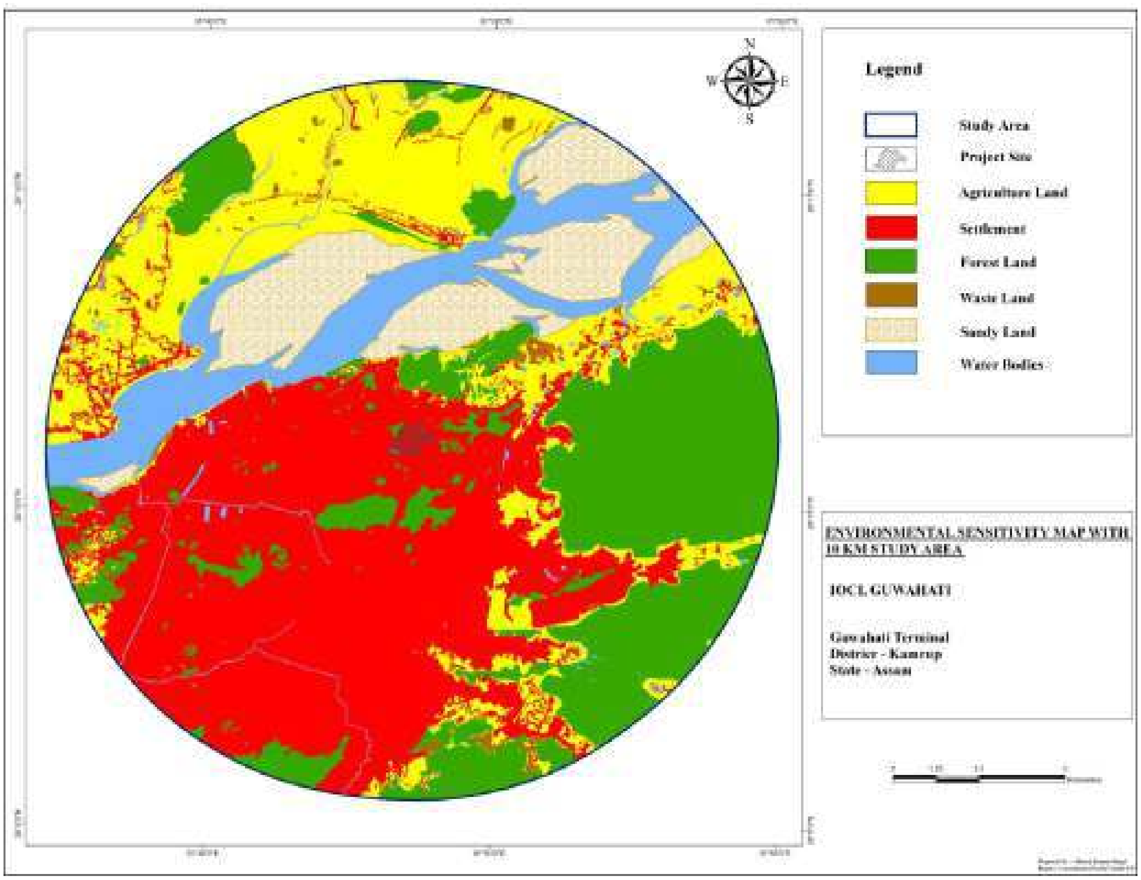


Figure 12: Land Use/Land Cover Map of IOCL Revamp Project

3.7.4 Soil Environment

Soil samples were collected from 4 different locations of the study area on 08.05.2014 – 09.05.2014 (**Table 17**) and were analyzed for the most relevant physical and chemical parameters including the heavy metals. Soil monitoring Photographs are given in

Table 17: Locations of the Soil Samples

S.No	Code	Village	Distance	Direction
1	S1	Noonmati	1.3	NW
2	S2	Barehapari	7.2	NE
3	S3	Sathgaon	6.3	SW
4	S4	Kalitakuchi	5	SE

Soil sampling at Noonmati

Soil sampling at Barchapari

Soil sampling at Sathgaon

Figure 13: Soil sample collection in the study area

It may be noted from the results of analysis (**Table 18)** that many of the soil samples have alkaline pH while the Assam soil is acidic in nature. The soil texture is dominated by sand in all the cases.

Table 18: Analysis of the Soil Sample Testing

S.No.	Physical	S1	S2	S3	S4
1	pH	7.41	7.28	7.21	6.98
2	Conductivity (mS/cm)	0.16	0.51	0.17	0.15
	Soil Texture (up to 60 cm)				
3	Sand (%)	80.0	70.0	81.2	77.7
4	Silt (%)	2.5	3.6	2.3	2.2
5	Clay (%)	17.5	26.4	16.5	20.1
6	Water Holding Capacity (%)	41.2	32.7	38.6	48.1
7	Bulk Density (g/cm^{-3})	1.5	1.42	1.51	1.48
8	CEC	10.05	15.92	9.99	10.89
9	SAR	0.074	0.154	0.102	0.073
9	Texture	Sandy loam	Sandy clay loam	Sandy loam	Sandy clay loam
	Chemical				
10	Nitrogen (%)	0.16	0.16	0.24	0.13
11	Potassium (mg/kg)	3.6	4.1	3.2	7.2
12	Sodium (mg/kg)	4.1	4.7	4.7	3.9
13	Calcium (mg/kg)	42.5	48.3	32.2	86.6
14	Magnesium (mg/kg)	117.0	13.6	78.0	78.0
15	Phosphorous (mg/kg)	0.15	0.52	0.45	0.41
16	Sulphate(mg/kg)	23.1	23.1	27.0	12.0
17	Chloride (mg/kg)	14.2	58.6	12.4	16.2
18	Organic matter (%)	0.65	1.36	0.87	0.42

3.8 Water Environment

Water samples were collected from 7 different locations of the study area (**Table 19**) and were analyzed for the most relevant physical and chemical parameters including the heavy metals **(Table-20).** The samples include both ground water and surface water locations for taking a proper consideration of impacts on water regime during 08.05.2014 – 09.05.2014.

Table 19 : Ground Water (GW) & Surface Water (SW) Monitoring Locations

S.No	Code	Village	Distance	Direction
1	SW1	Brahmaputra river near Khankar Gaon	5	NE
2	SW2	Brahmaputra river near Uzan Bazar	4.7	NW
3	SW3	Bamunimaidam	4	W
4	SW4	Fatasil Ambari	7.5	SW
5	GW1	Bamunimaidam	3	W
6	GW2	Kharghuli Gaon	1	N
7	GW3	Near Ulubari	5.8	SW

It is found that coliforms are present in surface water but there is no microbiological activity found in ground water. Also, most of the water characteristics of the surface and ground water are found within the range of CPCB guidelines. As per the approved ToR, last one year data of surface water and ground water is appended in the **Annexure X**.
Site photograph of the study area is given in **Figure-14.**

Brahmaputra River Downstream

Brahmaputra River upstream

Silpukhuri Pond

Pragjyotish college pond

Noonmati Water sample

Chandmari water sample

Figure 14: Water collection in the study area

Table 20 : Water Quality Characteristics

S.No	Parameter	Unit	Surface Water				Ground Water		
			SW 1	SW 2	SW 3	SW 4	GW 1	GW 2	GW 3
Physical Parameters									
1.	**pH**	-	7.58	7.62	7.71	7.44	7.03	7.60	7.5
2.	**Conductivity**	µS/cm	154	404	387	418	433	238	320
3.	**Total Dissolved Solids**	mg/l	100	263	258	278	281	155	200
4.	**Turbidity**	NTU	1.0	3.0	3.0	3.0	4.0	2.0	2.0
Chemical Parameters									
5.	**Total Alkalinity**	mg/l	28	76	90	98	68	60	70
6.	**Calcium Hardness**	mg/l	38	112	108	122	140	64	55
7.	**Magnesium Hardness**	mg/l	24	60	72	76	42	34	44
8.	**Total Hardness**	mg/l	62	172	180	198	182	98	99
9.	**Chloride**	mg/l	12	36	48	62	44	14	24
10.	**Nitrate as NO_3**	mg/l	1.8	3.6	4.8	6.5	3.7	2.3	2.5
11.	**Phosphate**	mg/l	0.14	0.22	0.28	0.32	0.24	0.13	0.20
12.	**Sulphate**	mg/l	30	70	86	90	77	33	55
13	**Dissolved Oxygen**	mg/l	8.0	7.8	5.4	5.1	--	--	--
14.	**Bio-Chemical Oxygen Demand**	mg/l	<2	<2	<2	<2	--	--	--
15.	**Chemical Oxygen Demand**	mg/l	<4	<4	<4	<4	--	--	--
16.	**Zinc as Zn**	mg/l	0.13	0.22	0.18	0.24	0.18	0.15	0.19
17.	**Iron as Fe**	mg/l	0.082	0.12	0.14	0.16	0.13	0.091	0.11
Bacteriological Parameters									
18.	**Total Coliform**	MPN /100 ml	26	34	320	448	Absent	Absent	Absent
19.	**Faecal Coliform**	MPN /100 ml	6	8	62	76	Absent	Absent	Absent
20.	**E.coli**	MPN / 100 ml	8	12	18	22	Absent	Absent	Absent

3.9 Air Environment

Air samples were collected from 5 different locations of the study area (**Table 21**) and were analyzed for the latest MoEF NAAQ Parameter

Table 21: Ambient Air Quality Montoring Location

S.No	Code	Village	Distance	Direction
1	A1	Lachit Nagar	3.5	SW
2	A2	Kahilipara	6.1	SW
3	A3	Beltola	6.7	S
4	A4	Refinery Guest House	0.0	E
5	A5	Panikhaiti Gaon	3	NE

The result of analysis of various ambient air quality parameters (average) during study period are given in the **Table 22,** while the **Table 23-28** shows the weekly monitoring data during study period. Baseline data of ambient air last one year are given in **Annexure-X**. Weekly monitoring data was collected twice a week from April 1st to June 30th.

AAQ Sampling at Lachit Nagar

AAQ sampling at Beltola

AAQ sampling at Panikhaiti Gaon

AAQ sampling at Kahilipara

Figure 15: Ambient air sampling in the study area.

Table 22: Average AAQ during study period (April 2014-June 2014)

	Concentration of Pollutants					
	SO_2	NO_2	PM $_{10}$	PM $_{2.5}$	THC's (Methane+Non-methane)	VOC's as Benzene (C_6H_6)
	µg/m^3	µg/m^3	µg/m^3	µg/m^3	ppm	µg/m3
CPCB Limit	**80**	**80**	**100**	**60**	**N.A.**	**5**
Location : Lachit Nagar						
	6.0	28.3	76.5	32.1	N.D.	N.D.
Location : Kahilipara						
	6.3	32.6	78.21	36.5	N.D.	N.D.
Location : Beltola						
	6.4	30.2	77.9	38.1	N.D.	N.D.
Location : Refinery Guest House						
	5.0	25.2	63.7	29.2	N.D.	N.D.
Location : Panikhaiti Gaon						
	5.0	29.4	72.3	30.8	N.D.	N.D.

Table 23 : Ambient air quality analysis at Lachit Nagar

April-June 2014 : Lachit Nagar						
Date	SO_2	NO_2	PM_{10}	$PM_{2.5}$	THC's (Methane + Non-methane)	VOC's as Benzene (C_6H_6)
	µg/m³	µg/m³	µg/m³	µg/m³	ppm	µg/m3
03/04/2014	7.2	27	75	24	N.D.(1.0)	N.D.(2.0)
05/04/2014	6.5	36	69	37	N.D.(1.0)	N.D.(2.0)
08/04/2014	4.5	23	85	22	N.D.(1.0)	N.D.(2.0)
12/04/2014	4.9	27	88	26	N.D.(1.0)	N.D.(2.0)
15/04/2014	5.6	30	70	25	N.D.(1.0)	N.D.(2.0)
19/04/2014	7.5	29	65	30	N.D.(1.0)	N.D.(2.0)
22/04/2014	8.8	29	62	25	N.D.(1.0)	N.D.(2.0)
26/04/2014	7.5	29	60	27	N.D.(1.0)	N.D.(2.0)
29/04/2014	4.8	35	81	38	N.D.(1.0)	N.D.(2.0)
03/05/2014	6.2	24	66	24	N.D.(1.0)	N.D.(2.0)
06/05/2014	6.8	30	85	23	N.D.(1.0)	N.D.(2.0)
10/05/2014	6.5	21	75	35	N.D.(1.0)	N.D.(2.0)
13/05/2014	5.5	32	75	29	N.D.(1.0)	N.D.(2.0)
17/05/2014	7.2	24	85	21	N.D.(1.0)	N.D.(2.0)
20/05/2014	6.6	22	88	32	N.D.(1.0)	N.D.(2.0)
24/05/2014	5.8	26	67	42	N.D.(1.0)	N.D.(2.0)
27/05/2014	4.2	28	89	35	N.D.(1.0)	N.D.(2.0)
30/05/2014	4.5	28	66	38	N.D.(1.0)	N.D.(2.0)
03/06/2014	5.5	28	84	39	N.D.(1.0)	N.D.(2.0)
07/06/2014	5.8	35	69	35	N.D.(1.0)	N.D.(2.0)
10/06/2014	5.7	28	78	43	N.D.(1.0)	N.D.(2.0)
14/06/2014	5.1	28	89	40	N.D.(1.0)	N.D.(2.0)
17/06/2014	4.5	39	66	38	N.D.(1.0)	N.D.(2.0)
21/06/2014	6.5	22	80	38	N.D.(1.0)	N.D.(2.0)
24/06/2014	6.8	33	85	30	N.D.(1.0)	N.D.(2.0)
28/06/2014	5.5	20	90	40	N.D.(1.0)	N.D.(2.0)
Minimum	**4.2**	**20**	**60**	**21**	**N.D**	**N.D**
Maximum	**8.8**	**39**	**90**	**43**	**N.D**	**N.D**
Average	**6.04**	**28.29**	**76.5**	**32.14**	**N.D**	**N.D**

ND=Not Detected (Figure in bracket indicates minimum detection limit)

Table 24 : Ambient air quality analysis at Kahili Para

April-June 2014 : Kahili Para						
Date	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**THC's (Methane + Non-methane)**	**VOC's as Benzene (C_6H_6)**
	µg/m^3	**µg/m^3**	**µg/m^3**	**µg/m^3**	**ppm**	**µg/m3**
03/04/2014	8.0	35	82	42	N.D.(1.0)	N.D.(2.0)
05/04/2014	8.0	30	88	40	N.D.(1.0)	N.D.(2.0)
08/04/2014	7.0	35	89	42	N.D.(1.0)	N.D.(2.0)
12/04/2014	5.0	29	83	38	N.D.(1.0)	N.D.(2.0)
15/04/2014	6.0	28	75	35	N.D.(1.0)	N.D.(2.0)
19/04/2014	8.0	33	89	34	N.D.(1.0)	N.D.(2.0)
22/04/2014	6.0	43	88	31	N.D.(1.0)	N.D.(2.0)
26/04/2014	4.2	32	89	36	N.D.(1.0)	N.D.(2.0)
29/04/2014	6.0	35	81	34	N.D.(1.0)	N.D.(2.0)
03/05/2014	8.0	40	75	31	N.D.(1.0)	N.D.(2.0)
06/05/2014	4.3	27	67	33	N.D.(1.0)	N.D.(2.0)
10/05/2014	6.0	28	66	40	N.D.(1.0)	N.D.(2.0)
13/05/2014	7.0	32	85	43	N.D.(1.0)	N.D.(2.0)
17/05/2014	8.0	27	83	38	N.D.(1.0)	N.D.(2.0)
20/05/2014	4.2	26	68	41	N.D.(1.0)	N.D.(2.0)
24/05/2014	5.0	37	83	42	N.D.(1.0)	N.D.(2.0)
27/05/2014	8.0	36	75	42	N.D.(1.0)	N.D.(2.0)
30/05/2014	8.0	37	85	23	N.D.(1.0)	N.D.(2.0)
03/06/2014	4.5	38	68	39	N.D.(1.0)	N.D.(2.0)
07/06/2014	7.0	39	74	35	N.D.(1.0)	N.D.(2.0)
10/06/2014	5.0	28	78	40	N.D.(1.0)	N.D.(2.0)
14/06/2014	6.0	22	76	36	N.D.(1.0)	N.D.(2.0)
17/06/2014	6.0	31	72	38	N.D.(1.0)	N.D.(2.0)
21/06/2014	4.5	38	64	32	N.D.(1.0)	N.D.(2.0)
24/06/2014	8.0	36	84	31	N.D.(1.0)	N.D.(2.0)
28/06/2014	6.0	25	70	39	N.D.(1.0)	N.D.(2.0)
Minimum	**4.2**	**22**	**64**	**23**	**N.D**	**N.D**
Maximum	**8.0**	**43**	**89**	**43**	**N.D**	**N.D**
Average	**6.28**	**32.57**	**78.21**	**36.46**	**N.D**	**N.D**

ND=Not Detected (Figure in bracket indicates minimum detection limit)

Table 25 : Ambient air quality analysis at Beltola

April-June 2014 : Beltola						
Date	**SO_2**	**NO_2**	**PM $_{10}$**	**PM $_{2.5}$**	**THC's (Methane + Non-methane)**	**VOC's as Benzene (C_6H_6)**
	µg/m^3	**µg/m^3**	**µg/m^3**	**µg/m^3**	**ppm**	**µg/m3**
03/04/2014	4.6	34	78	39	N.D.(1.0)	N.D.(2.0)
05/04/2014	4.5	40	72	36	N.D.(1.0)	N.D.(2.0)
08/04/2014	7.0	22	85	38	N.D.(1.0)	N.D.(2.0)
12/04/2014	7.0	23	88	42	N.D.(1.0)	N.D.(2.0)
15/04/2014	4.2	38	87	43	N.D.(1.0)	N.D.(2.0)
19/04/2014	4.5	35	68	41	N.D.(1.0)	N.D.(2.0)
22/04/2014	6.0	30	86	30	N.D.(1.0)	N.D.(2.0)
26/04/2014	8.0	37	90	34	N.D.(1.0)	N.D.(2.0)
29/04/2014	8.0	38	72	44	N.D.(1.0)	N.D.(2.0)
03/05/2014	4.2	17	64	40	N.D.(1.0)	N.D.(2.0)
06/05/2014	5.0	23	88	42	N.D.(1.0)	N.D.(2.0)
10/05/2014	8.0	35	90	42	N.D.(1.0)	N.D.(2.0)
13/05/2014	8.0	30	76	43	N.D.(1.0)	N.D.(2.0)
17/05/2014	6.0	31	86	38	N.D.(1.0)	N.D.(2.0)
20/05/2014	5.0	20	76	35	N.D.(1.0)	N.D.(2.0)
24/05/2014	6.0	18	88	41	N.D.(1.0)	N.D.(2.0)
27/05/2014	6.0	39	62	38	N.D.(1.0)	N.D.(2.0)
30/05/2014	8.0	34	88	40	N.D.(1.0)	N.D.(2.0)
03/06/2014	8.0	23	61	34	N.D.(1.0)	N.D.(2.0)
07/06/2014	8.0	35	88	36	N.D.(1.0)	N.D.(2.0)
10/06/2014	5.0	40	86	41	N.D.(1.0)	N.D.(2.0)
14/06/2014	8.0	39	85	38	N.D.(1.0)	N.D.(2.0)
17/06/2014	7.0	15	77	30	N.D.(1.0)	N.D.(2.0)
21/06/2014	6.0	36	69	40	N.D.(1.0)	N.D.(2.0)
24/06/2014	6.0	19	55	34	N.D.(1.0)	N.D.(2.0)
28/06/2014	7.0	39	72	35	N.D.(1.0)	N.D.(2.0)
Minimum	**4.2**	**15**	**55**	**30**	**N.D**	**N.D**
Maximum	**9.0**	**40**	**90**	**44**	**N.D**	**N.D**
Average	**6.39**	**30.18**	**77.93**	**38.14**	**N.D**	**N.D**

ND=Not Detected (Figure in bracket indicates minimum detection limit)

Table 26 : Ambient air quality analysis at Refinery Guest House

April-June 2014 : Refinery Guest House						
Date	**SO_2**	**NO_2**	**PM $_{10}$**	**PM $_{2.5}$**	**THC's (Methane + Non-methane)**	**VOC's as Benzene (C_6H_6)**
	µg/m^3	**µg/m^3**	**µg/m^3**	**µg/m^3**	**ppm**	**µg/m3**
03/04/2014	6.2	25	65	34	N.D.(1.0)	N.D.(2.0)
05/04/2014	4.8	31	69	26	N.D.(1.0)	N.D.(2.0)
08/04/2014	5.5	30	72	24	N.D.(1.0)	N.D.(2.0)
12/04/2014	6.1	32	52	28	N.D.(1.0)	N.D.(2.0)
15/04/2014	5.8	28	74	32	N.D.(1.0)	N.D.(2.0)
19/04/2014	5.1	15	51	35	N.D.(1.0)	N.D.(2.0)
22/04/2014	4.9	23	68	28	N.D.(1.0)	N.D.(2.0)
26/04/2014	4.2	17	58	20	N.D.(1.0)	N.D.(2.0)
29/04/2014	5.2	31	62	32	N.D.(1.0)	N.D.(2.0)
03/05/2014	5.8	22	57	36	N.D.(1.0)	N.D.(2.0)
06/05/2014	4.8	25	60	29	N.D.(1.0)	N.D.(2.0)
10/05/2014	5.2	22	63	30	N.D.(1.0)	N.D.(2.0)
13/05/2014	4.5	33	55	26	N.D.(1.0)	N.D.(2.0)
17/05/2014	5.1	31	56	32	N.D.(1.0)	N.D.(2.0)
20/05/2014	4.5	18	65	38	N.D.(1.0)	N.D.(2.0)
24/05/2014	5.5	26	82	21	N.D.(1.0)	N.D.(2.0)
27/05/2014	4.1	29	60	22	N.D.(1.0)	N.D.(2.0)
30/05/2014	4.9	26	55	27	N.D.(1.0)	N.D.(2.0)
03/06/2014	5.8	33	65	28	N.D.(1.0)	N.D.(2.0)
07/06/2014	4.5	22	54	21	N.D.(1.0)	N.D.(2.0)
10/06/2014	6.2	15	68	30	N.D.(1.0)	N.D.(2.0)
14/06/2014	4.8	27	69	33	N.D.(1.0)	N.D.(2.0)
17/06/2014	4.1	25	70	36	N.D.(1.0)	N.D.(2.0)
21/06/2014	4.8	26	75	38	N.D.(1.0)	N.D.(2.0)
24/06/2014	4.4	23	57	30	N.D.(1.0)	N.D.(2.0)
28/06/2014	4.2	22	68	25	N.D.(1.0)	N.D.(2.0)
Minimum	**4.1**	**15**	**51**	**20**	**N.D**	**N.D**
Maximum	**6.2**	**33**	**82**	**38**	**N.D**	**N.D**
Average	**5.05**	**25.18**	**63.68**	**29.25**	**N.D**	**N.D**

ND=Not Detected (Figure in bracket indicates minimum detection limit)

Table 27 : Ambient air quality analysis at Panikhaiti Gaon

April-June 2014 : Panikhaiti Gaon						
Date	**SO2**	**NO2**	**PM 10**	**PM 2.5**	**THC's (Methane + Non-methane)**	**VOC's as Benzene (C_6H_6)**
	µg/m3	**µg/m3**	**µg/m3**	**µg/m3**	**ppm**	**µg/m3**
03/04/2014	6.2	24	65	29	N.D.(1.0)	N.D.(2.0)
05/04/2014	4.8	37	82	20	N.D.(1.0)	N.D.(2.0)
08/04/2014	5.5	21	41	43	N.D.(1.0)	N.D.(2.0)
12/04/2014	6.1	40	59	34	N.D.(1.0)	N.D.(2.0)
15/04/2014	5.8	18	61	25	N.D.(1.0)	N.D.(2.0)
19/04/2014	5.1	25	64	24	N.D.(1.0)	N.D.(2.0)
22/04/2014	4.9	30	83	36	N.D.(1.0)	N.D.(2.0)
26/04/2014	4.2	25	75	36	N.D.(1.0)	N.D.(2.0)
29/04/2014	4.1	19	59	24	N.D.(1.0)	N.D.(2.0)
03/05/2014	4.9	35	81	39	N.D.(1.0)	N.D.(2.0)
06/05/2014	5.8	25	82	21	N.D.(1.0)	N.D.(2.0)
10/05/2014	4.5	20	81	41	N.D.(1.0)	N.D.(2.0)
13/05/2014	6.2	19	86	28	N.D.(1.0)	N.D.(2.0)
17/05/2014	4.8	27	78	24	N.D.(1.0)	N.D.(2.0)
20/05/2014	4.1	27	89	34	N.D.(1.0)	N.D.(2.0)
24/05/2014	4.8	29	78	28	N.D.(1.0)	N.D.(2.0)
27/05/2014	4.4	40	84	27	N.D.(1.0)	N.D.(2.0)
30/05/2014	4.9	31	82	27	N.D.(1.0)	N.D.(2.0)
03/06/2014	5.8	28	89	39	N.D.(1.0)	N.D.(2.0)
07/06/2014	4.5	31	70	30	N.D.(1.0)	N.D.(2.0)
10/06/2014	6.2	41	72	20	N.D.(1.0)	N.D.(2.0)
14/06/2014	4.8	23	74	36	N.D.(1.0)	N.D.(2.0)
17/06/2014	4.9	39	56	38	N.D.(1.0)	N.D.(2.0)
21/06/2014	4.8	25	65	38	N.D.(1.0)	N.D.(2.0)
24/06/2014	4.4	42	69	25	N.D.(1.0)	N.D.(2.0)
28/06/2014	4.1	42	69	34	N.D.(1.0)	N.D.(2.0)
Minimum	**4.1**	**18**	**41**	**20**	**N.D**	**N.D**
Maximum	**6.2**	**42**	**89**	**43**	**N.D**	**N.D**
Average	**5.03**	**29.39**	**72.29**	**30.82**	**N.D**	**N.D**

ND=Not Detected (Figure in bracket indicates minimum detection limit)

3.10 Analysis and Interpretation of Data

Analysis and interpretation of ambient air quality data collected during the study period, including comparison with air quality standards is as follows.

Sulphur dioxide (SO_2):
Sulphur dioxide concentrations in the study area were observed from the minimum of 4.2 $\mu g/m^3$ to the maximum value of 9.0 $\mu g/m^3$. The minimum concentrations observed at the 5 sampling stations were in the range 4$\mu g/m^3$ to 5 $\mu g/m^3$, whereas the maximum concentrations were observed in the range 8 to 9 $\mu g/m^3$, and the average concentrations in the range 6 to 7 $\mu g/m^3$. These maximum observed values are well within the ambient air quality standard (80 $\mu g/m^3$) for Industrial, residential, rural and other areas.

Nitrogen dioxide (NO_2):
Nitrogen dioxide concentrations in the study area were observed from the minimum of 15 $\mu g/m^3$ to the maximum value of 43 $\mu g/m^3$. The minimum concentrations observed at the 5 sampling stations were in the range 15 $\mu g/m^3$ to 20 $\mu g/m^3$, whereas the maximum concentrations were observed in the range 33 to 43 $\mu g/m^3$, and the average concentrations in the range 28 to 32 $\mu g/m^3$. These maximum observed values are well within the ambient air quality standard (80 $\mu g/m^3$) for Industrial, residential, rural and other areas.

Particulate matter (PM10):
Concentrations of particulate matter less than 10 µm size (PM_{10}) in the study area were observed from the minimum of 41 $\mu g/m^3$ to the maximum value of 90 $\mu g/m^3$. The minimum concentrations observed at the 5 sampling stations were in the range 41$\mu g/m^3$ to 55 $\mu g/m^3$, whereas the maximum concentrations were observed in the range 80 to 90 $\mu g/m^3$, and the average concentrations in the range 70 to 80 $\mu g/m^3$. The maximum observed values at all the 5 locations are well below the ambient air quality standard (100 $\mu g/m^3$) for Industrial, residential, rural and other areas.

Particulate matter (PM2.5):
Concentrations of particulate matter less than 2.5 µm size ($PM_{2.5}$) in the study area were observed from the minimum of 20 $\mu g/m^3$ to the maximum of 44 $\mu g/m^3$. The minimum concentrations observed at the 5 sampling stations were in the range 20$\mu g/m^3$ to 30 $\mu g/m^3$, whereas the maximum concentrations were observed in the range 40 to 45 $\mu g/m^3$, and the average concentrations in the range 30 to 35 $\mu g/m^3$. The maximum observed values at all the 5 locations are well below the ambient air quality standard (60 $\mu g/m^3$) for Industrial, residential, rural and other areas.

VOC'S
Volatile organic compound as Benzene was found in the study area are BDL (Below Detection Limit)
THC's
Total Hydro Carbon (as Methane and Non-methane) concentrations in the study area were not detected. No limit of Hydrocarbon in the ambient air has been specified in the NAAQS.

3.11 Noise Environment

Noise monitoring was done at 5 different locations of the study area (**Table 29**) and the results Leq (dBA) are given in **Table 30** for both day and night time.

Noise monitoring at Refinery Guest House

Noise monitoring at Beltola

Nose monitoring at Lachit Nagar

Noise monitoring at Kahilipara

Noise monitoring at Panikhaitigaon

Other Noise monitoring in study area

Figure 16: Noise monitoring in the study area

Table 28: Noise Monitoring Location

S.No	Code	Village	Distance	Direction
1	N1	Lachit Nagar	4	SW
2	N2	Kahilipara	6.5	SW
3	N3	Beltola	6.9	S
4	N4	Refinery Guest House	0.0	E
5	N5	Panikhaiti Gaon	2.6	NE

Table 29: Noise Result

S.No.	Location	Day (Ld)	CPCB Standard Limit Day dB(A)	Night (Ln)	CPCB Standard Limit Night dB (A)
1	N1	50	55	40.3	45
2	N2	48	55	40	45
3	N3	49.5	55	41.7	45
4	N4	65	75	58	70
5	N5	51	55	41.6	45

3.12 Biological Environment

Biological environment is an integrate part of the environment, it constitute all living beings of that area. Hence, any change in the surrounding environment could cause loss of species or decrease in biodiversity of the area. Therefore, the present study is proposed to assess the impact of proposed project on biological environment. Accordingly, mitigation measures are evolved to sustain the biological diversity. Field survey was conducted for baseline study of existing ecological environment during April-June, 2014. In general Biological diversity is represented by flora and fauna. For the study of biological environment of any area Flora is categorized mainly in to three groups as herbs, shrubs and trees; similarly fauna is divided into mammals, birds and reptiles.

3.12.1 Objectives

The biological study of the study area has been conducted in order to understand the ecological status of the existing flora and fauna to generate baseline information and evaluate the probable impacts on the biological environment.

3.12.2 General Vegetation & Forest

Assam state is part of the transition zone between the Indo-Malayan and Indo-Chinese biogeographical regions. It falls within the biogeographic Zone of Brahmaputra Valley. Favorable climate, topographic and edaphic factors support luxuriant growth of diverse plant communities and create varied habitats. The wet Evergreen, semi Evergreen, moist Deciduous, wet Savannah and Riparian forests as well as extensive network of river systems and swamps, marshes and wetlands provide ideal conditions and suitable habitats for subsistence of a wide variety of fauna be it mammals, primates, reptiles, amphibians, fish, molluscs, birds, butterflies, moths, that is, they support the existence of one of the most diverse faunal population.

The project site i.e. IOCL Refinery is located in Guwahati city in Kamrup district of Assam. The landscape of the 10 km radius study area of this project is almost plain with hills areas. In general the altitude of the area is ranging from 40m to 450m MSL. The rain fall in this area is varying from 1500-2400mm. This topography and climatological condition supports Tropical forests in this area. As per Champion & Seth this area harbours tropical moist deciduous forest. The Brahmaputra river flows in East to West direction.

The primary data from the site survey as well as secondary data from Forest department & published literatures have been collected for inventorising the flora and fauna of the project area.

3.12.3 Terrestrial Ecology

3.12.3.1 Floral Diversity

Guwahati is situated in district Kamrup which has 1432 sq. km of forest area, comprising of:

- 69 sq.km of very dense forest,
- 609 sq.km of moderately dense forest &
- 754 sq. km of open forest.

The forest in this region comprises of Tropical Moist Deciduous type forests. This forest is further divided into Sal forest and mixed deciduous forest. In these forests, Sal grows in association with Ajar (Lagerstoemia species), Ghugra (Schima wallichii), Paruli (Stereospermum prsonatum), Haldu (Adina cordifolia), Sam (Artocarpus sp.), Bor (Ficus sp.), Uraim (Bischofia javanica), Gomari (Gmelina arborea), Teeta champa (Michelia champa), Poma (Toona ciliata). Efforts were focused on intensive studies of the ecological habitat, vegetation composition and the presence of faunal groups specifically around the areas where impact may occur, both during the constructional as well as the operational phase.

3.12.3.2 Flora of the Core area

The field visit to the project area has been carried out to inventories the flora of the area. Different areas inside the refinery complex viz office front area, ETP region, API separator area, TPS area, Cooling tower area, DM plant area etc. were visited to collect the baseline data. It is found that 29 tree species, 28 herbs, 11 shrubs and 01 climber and 01 orchid species are reported from the core area. The analysis of the flora of the area is presented in Table-32. Details of all plant species has been given in **Table no. 33**.

Table 30: Analysis of the flora of the study area

Sl. No.	Habitat	No. of Species
1.	Trees	29
2.	Shrubs	11
3.	Herbs	28
4.	Climbers	01
5.	Orchid	01
Total		**70**

Table 31: List of Flora found in Core zone & buffer zone

S/n	Scientific Name	Habit	Location Core	Location Buffer
1.	*Aerva sanguinolenta*	Shrub	√	-
2.	*Araucaria bidwillii* Hook.	Tree	√	-
3.	*Araucaria cunninghamii*	Tree	√	-
4.	*Borassus flabellifar*	Tree	√	-
5.	*Cassuarina equisetifolia*	Tree	√	-
6.	*Desmodium trifolium*	Herb	√	-
7.	*Abrus precatorius* L.	Herb	√	√
8.	*Abutilom indicum G. Don.*	Herb	-	√
9.	*Acacia auriculiformis* A. Cunn. ex Benth.	Tree	√	√

10.	*Acalypha indica* L.	Herb	√	√
11.	*Achyranthus aspera* L.	Herb	√	√
12.	*Adiantum caudatum*	Fern	-	√
13.	*Adiantum philippense*	Fern	-	√
14.	*Aegle marmelos*	Tree	√	√
15.	*Aerides odoratum*	Orchid	-	√
16.	*Agave americana*	Shrub	-	√
17.	*Ageratum conizoides*	Herb	-	√
18.	*Ageratum conyzoides L.*	Herb	-	√
19.	*Albizzia lebbek*	Tree	√	√
20.	*Alocasia cucullata schott.*	Herb	-	√
21.	*Alocasia indica (Lour) koch*	Herb	-	√
22.	*Aloe barbedense*	Shrub	√	√
23.	*Alstonia scolaris*	Tree	√	√
24.	*Alternanthera philoxeroides*	Herb	-	√
25.	*Alternanthera sessilis* (L.) R. Br.ex.Dc.	Herb	√	√
26.	*Amaranthus spinosus L.*	Herb	√	√
27.	*Amaranthus variegata*	Herb	-	√
28.	*Amaranthus viridis* L.	Herb	√	√
29.	*Amorphophallus campanulatus.*	Herb	-	√
30.	*Andropogon ascinodis*	Grass	√	√
31.	*Angiopleris evecta*	Fern	-	√
32.	*Anthocephalus cadamba Miq.*	Tree	-	√
33.	*Araucaria cookii*	Tree	√	√
34.	*Areca catechu* L.	Tree	√	√
35.	*Argenone maxicana L.*	Shrub	-	√
36.	*Artocarpus heterophyllus*	Tree	√	√
37.	*Artocarpus integrifolia* L.	Tree	-	√
38.	*Asplenium nidus*	Fern	-	√
39.	*Auxzonopus compressus*	Grass	√	√
40.	*Azadirachta india* A. Juss.	Tree	√	√
41.	*Azolla pinnata*	Fern	-	√
42.	*Bambusa sp.*	Herb	-	√
43.	*Basella alba* L.	Climber	-	√
44.	*Bauhinia accuminata*	Tree	√	√
45.	*Boerhavia diffusa* L.	Herb	-	√
46.	*Boerhavia repens* L.	Herb	-	√
47.	*Borreria articularis* (L.f.) F.N.Will.	Herb	-	√
48.	*Bougainvillea spectabilis*	Shrub	√	√
49.	*Bryophyllum pinnatum Roxb.*	Herb	√	√
50.	*Bulbophyllum careyanum*	Orchid	-	√
51.	*Caesalpinia pulcherima* (L.) Sw.	Tree	√	√

52.	*Calensuo sp.*	Shrub	-	√
53.	*Callistemon citrinus* (Curtis) Stapff.	Tree	√	√
54.	*Canna indica* L.	Shrub	√	√
55.	*Cannabis sativa* L.	Shrub	-	√
56.	*Cardiopermum helicacabum* L.	Climber	-	√
57.	*Carex spp.*	Grass	√	√
58.	*Carica papaya* L.	Tree	-	√
59.	*Cassia fistula*	Tree	√	√
60.	*Catharanthus roseus* (L.) G. Don.	Shrub	√	√
61.	*Celosia critata* L.	Herb	-	√
62.	*Centella asiatica* (L.) Urban	Herb	-	√
63.	*Chenopodium album* L.	Herb	-	√
64.	*Chrysopogon aciculatus*	Herb	√	√
65.	*Cinamomum tamala*	Tree	√	√
66.	*Citrus sp.*	Tree	√	√
67.	*Cleome gynandra* L.	Herb	-	√
68.	*Cleome rutidosperma* DC.	Herb	-	√
69.	*Cleome viscosa* L.	Herb	-	√
70.	*Clerodendron viscum* Vent.	Herb	√	√
71.	*Clitoria ternatea* L.	Climber	-	√
72.	*Coccinia grandis* (L.) Voigt.	Climber	-	√
73.	*Cocos nucifera* L.	Tree	√	√
74.	*Codiaeum variegatum* (L.) Bl.	Tree	-	√
75.	*Colocasia esculenta (L.) Schott.*	Herb	-	√
76.	*Commelina benghalensis L.*	Herb	√	√
77.	*Commelina diffusa*	Herb	√	√
78.	*Crinum asiaticum*	Herb	√	√
79.	*Crysopogon aciculatia*	Grass	√	√
80.	*Curcuma aromatica Salish.*	Herb	√	√
81.	*Cuscuta reflexa Roxb.*	Climber	√	√
82.	*Cyclosorus extensum*	Fern	-	√
83.	*Cymbidium oloifolium*	Orchid	√	√
84.	*Cynodon dactylon (L.) Pers.*	Herb	√	√
85.	*Cyperus brevifolius* (Rottle) Hassk.	Herb		√
86.	*Cyperus brevifolius (Rottle.) Hassk.*	Herb		√
87.	*Cyperus compressus L.*	Herb	√	√
88.	*Cyperus distans L.*	Herb	-	√
89.	*Cyperus iria L.*	Herb	-	√
90.	*Dalbergia sisso* Roxb.	Tree	√	√
91.	*Datura metal L.*	Shrub	-	√
92.	*Delonix regia* (Bojr.) Rsf.	Tree	√	√
93.	*Dendrobium nobile*	Orchid	-	√

94.	*Dendrobium sp.*	Orchid	-	√
95.	*Dendrocalamus hamiltonii Nees.*	Herb	-	√
96.	*Desmodium triphylla*	Herb	-	√
97.	*Digitaria saligera*	Grass	√	√
98.	*Diplazium esculentum*	Fern	-	√
99.	*Discorea alata L.*	Climber	-	√
100.	*Dracaena sp.*	Shrub	√	√
101.	*Drymaria cordata* (L.) Willd. Ex R. & S.	Herb	-	√
102.	*Drynaria quercifolia*	Fern	-	√
103.	*Drynaria sp.*	Fern	-	√
104.	*Duranta repens*	Shrub	√	√
105.	*Duranta repens*	Herb	-	√
106.	*Dysoxylum biopectinatum*	Tree	√	√
107.	*Eclipta prostrata* (L.) L.	Herb	√	√
108.	*Eichhornia crassipes (Mart.) Solms.*	Tree	-	√
109.	*Elephantopus scaber L.*	Herb	√	√
110.	*Eleusine indica (L.) Gaert.*	Herb	√	√
111.	*Embelica officinalis*	Tree	√	√
112.	*Eucalyptus globosus*	Tree	√	√
113.	*Eucalyptus hybrid*	Tree	√	√
114.	*Euphorbia hirta L.*	Herb	√	√
115.	*Euphorbia nerifolia*	Herb	√	√
116.	*Evolvulus nummularius*	Herb	√	√
117.	*Ficus benghalensis L.*	Tree	√	√
118.	*Ficus religiosa L.*	Tree	√	√
119.	*Foeniculum vulgare* Gaertn	Herb	-	√
120.	*Geodorum sp.*	Orchid	-	√
121.	*Glorisa superba L.*	Climber	-	√
122.	*Grevellia robusta*	Tree	√	√
123.	*Gymnogramme pulchellus*	Fern	-	√
124.	*Hedyotis scandens*	Herb	√	√
125.	*Hemionites aurifolia*	Fern	-	√
126.	*Hibiscus rosa sinensis* L.	Tree	√	√
127.	*Imperata cylindrica* (L.) Beauv.	Herb	-	√
128.	*Ipomea fistulosa*	Herb	-	√
129.	*Ipomoea aquatica Forssk.*	Climbers	-	√
130.	*Ipomoea cirica*	Climbers	-	√
131.	*Ipomoea quamoclit L.*	Climber	-	√
132.	*Ixora arborea*	Shrub	√	√
133.	*Ixora coccinea* Roxb.	Shrub	√	√
134.	*Senna sophera* L.	Shrub	√	√
135.	*Senna tora* (L.) Roxb.	Shrub	√	√

3.12.3.3 Flora of the Buffer area

The buffer area i.e. 10 km radius of the refinery was surveyed for the study of Ecology & Biodiversity. Major parts of the study area includes the human settlement of the Guwahati city, however the Aamchung sanctuary and the Reserve forest, and Brahamputra rivers forms the part of the study area. The areas of Guwahati which come under 10 km radius of the refinery are Chandmari, Kamakhya, Khanapara, Hengerbarui, Ganeshguri, etc. Total 129 species are reported from buffer area. Out of which 34 tree species, 58 herbs, 16 shrubs, 10 climbers and 06 orchid species are reported from the buffer area. The analysis of the flora of the area is presented in **Table-33**.

Table 32: Analysis of the flora of the buffer area

Sl. No.	Habitat	No. of Species
1.	Trees	34
2.	Shrubs	16
3.	Herbs	58
4.	Climbers	10
5.	Orchid	06
6	Ferns	11
Total		**135**

3.12.3.4 Fauna of the Area

The information of important terrestrial animal groups such as birds, reptiles and mammals were collected by trekking inhabiting area, along the road, nearby forest areas and agricultural fields present in the impact zone. An inventory of the animals has been prepared separately for mammals, reptiles and birds. Total of Twenty seven species of mammals, Fifty four species of birds and twenty species of reptile which are inventorised from the study area. The species lists of animals recorded from primary survey & secondary sources during this study are given below in Table. No. 34 (A, B & C) & is represented in **figure no. 17**.

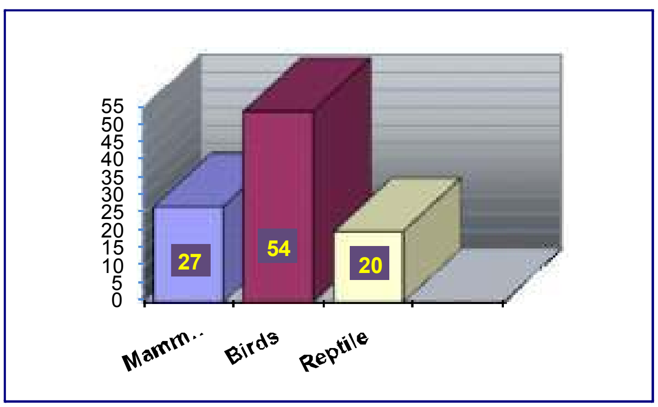


Figure 17 : Fauna of the Project area

Table 33 (A, B & C): Details of Fauna present in the Study Area

A. **MAMMALS (in study area):**

SN	*Common Name*	*Scientific Name*	*Status*
1.	*Hog Deer*	*Axis porcinus*	*EN*
2.	*Wild Boar*	*Sus scrofa*	*LC*
3.	*Leopard Cat*	*Prionailurus bengalensis*	*S-I/LC*
4.	*Jungle Cat*	*Felis chaus*	*LC*
5.	*Asiatic Jackal*	*Canis aureus*	*LC*
6.	*Bengal Fox*	*Vulpes bengalensis*	*LC*
7.	*Small Indian Civet*	*Viverricula indica*	*LC*
8.	*Common Palm Civet*	*Paradoxurus hermaphroditus*	*LC*
9.	*Indian Grey Mongoose*	*Herpestes edwardsii*	*LC*
10.	*Small Asian Mongoose*	*Herpestes javanicus*	*LC*
11.	*Western Hoolock Gibbon*	*Hoolock hoolock*	*S-I/EN*
12.	*Rhesus Macaque*	*Macaca mulatto*	*LC*
13.	*Assam Macaque*	*Macaca assamensis*	*NT*
14.	*Capped Langur*	*Trachypithecus pileatus*	*S-I/VU*
15.	*Bengal Slow Loris*	*Nycticebus bengalensis*	*VU*
16.	*Chinese Pangolin*	*Manis pentadactyla*	*S-I/EN*
17.	*Indian Palm Squirrel*	*Funambulus palmarum*	*LC*
18.	*Porcupine*	*Hystrix brachyura*	*LC*
19.	*Lesser Bandicoot Rat*	*Bandicota bengalensis*	*LC*
20.	*Hoary Bamboo Rat*	*Rhizomys pruinosus*	*LC*
21.	*Indian flying Fox*	*Pteropus giganteus*	*LC*
22.	*Short nosed Indian fruit Bat*	*Cynopterus sphinx*	*LC*
23.	*Least horseshoe Bat*	*Rhinolophus pusiilus*	*LC*
24.	*Lesser Asiatic yellow Bat*	*Scotophilus kuhlii*	*LC*
25.	*Asian House Shrew*	*Suncus murinus*	*LC*
26.	*Mole Shrew*	*Anourosorex squamipes*	*LC*
27.	*Gangetic Dolphin*	*Platanista gangetica*	*S-l/EN*

(S-I- Schedule-I of WPA- 1972; EN- Endangered; VU- Vulnerable; NT- Near Threatened; LC- Least Concern in IUCN red list)

B. REPTILES (in study area):

Sl. No.	Local Name	Zoological Name	*Status*
1.	Tree frog	*Polypedates leucomystax*	LC
2.	Ornamented Pygmy Frog	*Microhyla ornate*	LC
3.	Indian bull frog	*Hoplobatrachus tigerinus*	LC
4.	Common Pond Frog	*Fejervarya limnocharis*	LC
5.	Assam Hills Frog	*Clinotarsus alticola*	LC
6.	Water frog	*Hylarana garoensis*	LC
7.	AsiaticRock	*Python Python molurus*	LR/NT
8.	Common Rat Snake	*Ptyas mucosus*	LC
9.	North-eastern Kukri Snake	*Oligodon cyclurus*	LC
10.	Rat Snake	*Coelognathus radiatus*	LC
11.	Golden Tree Snake	*Chrysopelea ornata*	LC
12.	Banded Krait	*Bungurus fasciatus*	LR/ NT
13.	House Gecko	*Hemidactylus frenatus*	LC
14.	Indian Garden Lizard	*Calotes versicolor*	LR/ NT
15.	AsiaticRock Python	*Python molurus*	LC
16.	Indian Roofed Turtle	*Pangshura tecta*	LR/LC
17.	South Asian Box Turtle	*Cuora amboinensis*	LC
18.	Indian Soft Shell Turtle	*Nilssonia gangetica*	LC
19.	Peacock soft shell Turtle	*Nilssonia hurum*	LC
20.	Indian Flap-shell Turtle	*Lissemys punctata*	LC

C. Birds (in study area):

S.No.	Common Name	Scientific Name	Status
1.	Little Grebe	*Tachybaptus ruficollis*	LC.
2.	Great Crested Grebe	*Podiceps cristatus*	LC
3.	Great cormorant	*Phalacrocorcix carbo*	LC
4.	Little cormorant	*Phcdacrocorax niger*	LC
5.	Oriental Darter	*Anhinga melanogaster*	NT
6.	Grey Heron	*Ardea cinerea*	LC
7.	Cattle Egret	*Bubulcus ibis*	LC
8.	Great Egret	*Casmerodius dibits*	LC
9.	Purple Heron	*Ardea purpurea*	LC
10.	Indian pond Heron	*Ardeola grayii*	LC
11.	Intermediate Egret	*Ardea intermedia*	LC
12.	Little Egret	*Egretta garzetta*	LC
13.	Cinnamon Bittern	*Ixubrychus cinnamomeus*	LC
14.	Great Bittern	*Botaurus stellaris*	LC
15.	Black crown Night Heron	*Nycticorax nycticorax*	LC
16.	Asian Open bill	*Anastonnis oscitans*	LC
17.	Lesser Adjutant Stork	*Leptoptilos javanicus*	VU

18.	Lesser Whistling Duck	*Dendrpcygna javanica*	-
19.	Fulvous Whistling Duck	*Dendrocygna bicolor*	LC
20.	Ruddy Shelduck	*Tadorna ferruginea*	LC
21.	Pintail	*Anas acuta*	LC
22.	Common Teal	*Anas crecca*	LC
23.	Bar Headed Goose	*Anser indicus*	L/C
24.	Cotton Pygmy Goose	*Nettapus coromandelianus*	LC
25.	Tufted Duck	*Aythya fuligula*	
26.	Swamp Francolin	*Francolinus gulans*	VU
27.	Kalij Pheasant	*Lophura leucomelanos*	LC
28.	Black Francolin	*Francolinus francolinus*	LC
29.	Red Jungle Fowl	*Gallus gallus*	LC
30.	Water Cock	*Gallicrex cinerea*	LC
31.	White breasted Waterhen	*Amaurornis phoenicurus*	LC
32.	Common Moorhen	*Gallinula chloropus*	LC
33.	Purple Swamphen	*Porphyria porphyrio*	
34.	Water Rail	*Rallus aquaticus*	LC
35.	Common Coot	*Fulica atra*	LC
36.	Pheasant -Tailed Jacana	*Hydrophasianus chirurgus*	LC
37.	Bronze winged Jacana	*Metopidius indicus*	LC
38.	Grey headed Lapwing	*Vanellus cinereus*	LC
39.	Northern Lapwing	*Vanellus vanellus*	LC
40.	Red wattled Lapwing	*Vanellus indicus*	LC
41.	Common Name	*Scientific Name*	LC
42.	Little Ringed Plover	*Charadrius dubius*	LC
43.	Wood Sandpiper	*Tringa glareola*	LC
44.	Common Sandpiper	*Actitis hypoleucos*	LC
45.	Little Green Bee-eater	*Merops orientalis*	LC
46.	Oriental Pied Hornbill	*Anthracoceros albirostris*	LC
47.	Indian Roller	*Coracias benghalensis*	LC
48.	Lineated Barbet	*Megalaima lineata*	LC
49.	Blue throated Barbet	*Megalaima asiatica*	LC
50.	Copper smith Barbet	*Megalaima haemacephala*	LC
51.	Greater Flame back	*Chrysocolaptes lucidus*	LC
52.	Black rumped Flameback	*Dinopium benghalense*	LC
53.	Grey headed fish Eagle	*Ichthyophaga ichthyaetus*	LC
54.	Pallas's Fishing Eagle	*Haliaeetus leucoryphus*	VU

S*econdary Source: Forest Department Working Plan & questionnaire from village people.*

3.13 Socio-Economic Environment

3.13.1 Approach & Methodology Adopted

Study has been conducted based on the primary as well as Secondary Data: Socio-economic profile has been compiled from census data (2001 & 2011), while primary verification has been carried out by using sample site survey. As the study area is too large so the study has been carried out at district level representing the whole study area for detailed socio-economic analysis.

3.13.2 Description of the Study Area

The study area covers Kamrup District in the state of Assam . Area and the villages/ part of villages located in the 10 Km radius around the project area periphery. The following sections present the socio-economic profile of the village falling in the study area (demography, literacy, occupation, etc) based on secondary data available from primary census abstract, census of India, 2001 and 2011, village directory of Assam, census of India 2011, Administrative Atlas of Assam 2011, for detailed socio-economic analysis, sub district has been taken as the minimum unit. Figure 18 represent socio-economic survey in the study area.

Figure 18: Socio-Economic survey in the study area

There are 25 villages that fall under the study area of the proposed project. Out of these 5villages come under tahsil Dispur, Sonapur, Chandrapur & Guwahati in Kamrup District. The District and tahsil details are presented in **Table 35.**

Table 34: List of villages in the study area

S.No.	Village Name	Sub District	District
1	Kamrup (Urban)	Kamrup	Kamrup
2	Guwahati (Urban)	Guwahati	Kamrup
3	Dispur (Urban)	Dispur	Kamrup
4	Tintukura N.C.	Dispur	Kamrup
5	Kharghuli	Dispur	Kamrup
6	Amseng	Sonapur	Kamrup
7	Bamunkhat N.C	Sonapur	Kamrup
8	Amseng N.C.	Sonapur	Kamrup
9	Bozra N.C.	Sonapur	Kamrup
10	Kamarkuchi	Sonapur	Kamrup
11	Kharghuli N.C.	Chandrapur	Kamrup
12	Panikhaiti	Chandrapur	Kamrup
13	Khankar	Chandrapur	Kamrup
14	Hojobari	Chandrapur	Kamrup
15	Barchapahi	Chandrapur	Kamrup
16	Tatimara	Chandrapur	Kamrup
17	Thakurkuchi Gaon	Chandrapur	Kamrup
18	2 No. Thakurbari	Chandrapur	Kamrup
19	Bonda	Chandrapur	Kamrup
20	2 No. Bonda	Chandrapur	Kamrup
21	Thakurkuchi N.C.	Chandrapur	Kamrup
22	Khankar N.C.	Chandrapur	Kamrup
23	Kalitakuchi N.C.	Dispur	Kamrup
24	No.1 Bonda Grant	Dispur	Kamrup
25	No.2 Bonda Grant	Dispur	Kamrup

3.13.3 Kamrup District Overview

An official Census 2011 detail of Kamrup a district of Assam has been released by Directorate of Census Operations in Assam. Enumeration of key persons was also done by census officials in Kamrup District of Assam.

3.13.3.1 Kamrup District Population 2011

In 2011, Kamrup had population of 1,517,542 of which male and female were 778,461 and 739,081 respectively. In 2001 census, Kamrup had a population of 1,311,698 of which males were 678,310 and remaining 633,388 were females.

3.13.3.2 Kamrup District Population Growth Rate

There was change of 15.69 percent in the population compared to population as per 2001. In the previous census of India 2001, Kamrup District recorded increase of 14.97 percent to its population compared to 1991.

3.13.3.3 Kamrup District Density 2011

The initial provisional data released by census India 2011, shows that density of Kamrup district for 2011 is 489 people per sq. km. In 2001, Kamrup district density was at 382 people per sq. km. Kamrup district administers 3,105 square kilometers of areas.

3.13.3.4 Kamrup Literacy Rate 2011

Average literacy rate of Kamrup in 2011 were 75.55 compared to 67.73 of 2001. If things are looked out at gender wise, male and female literacy were 81.30 and 69.47 respectively. For 2001 census, same figures stood at 75.89 and 58.95 in Kamrup District. Total literate in Kamrup District were 995,319 of which male and female were 550,219 and 445,100 respectively. In 2001, Kamrup District had 9,267,515 in its district.

3.13.3.5 Kamrup Sex Ratio 2011

With regards to Sex Ratio in Kamrup, it stood at 949 per 1000 male compared to 2001 census figure of 934. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 967 girls per 1000 boys compared to figure of 964 girls per 1000 boys of 2001 census data. Kamrup district detail is represented in Table-36.

Table 35: Kamrup District at a Glance

Description	2011	2001
Actual Population	1,517,542	1,311,698
Male	778,461	678,310
Female	739,081	633,388
Population Growth	15.69%	14.97%
Area Sq. Km	3,105	3,105
Density/km2	489	382
Proportion to Assam Population	4.86%	4.92%
Sex Ratio (Per 1000)	949	934
Child Sex Ratio (0-6 Age)	967	964
Average Literacy	75.55	67.73
Male Literacy	81.30	75.89
Female Literacy	69.47	58.95
Total Child Population (0-6 Age)	200,061	204,843

Male Population (0-6 Age)	101,716	104,324
Female Population (0-6 Age)	98,345	100,519
Literates	995,319	9,267,515
Male Literates	550,219	5,088,530
Female Literates	445,100	4,178,984
Child Proportion (0-6 Age)	13.18%	15.62%
Boys Proportion (0-6 Age)	13.07%	15.38%
Girls Proportion (0-6 Age)	13.31%	15.87%

3.13.4 Concepts & Definition

a. Study Area: The study area, also known as impact area has been defined as the sum total of core area and buffer area with a radius of 10 Kilometers from the periphery of the core area. The study area includes all the land marks both natural and manmade, falling therein.

b.QoL: The Quality of Life (QoL) refers to degree to which a person enjoys the important possibilities of his/her life. The 'Possibilities' result from the opportunities and limitations, each person has in his/her life and reflect the interaction of personal and environmental factors. Enjoyment has two components: the experience of satisfaction and the possession or achievement of some characteristic.

c. Household: A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one member households, two member households or multi-member households.

d. Sex Ratio: Sex ratio is the ratio of females to males in a given population. It is expressed as 'number of females per 1000 males'.

e. Literates: All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

f. Literacy Rate: Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

g. Labour Force: The labour force is the number of people employed and unemployed in a geographical entity. The size of the labour force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labour force of a country consists of everyone of working age (around 14 to 16 years) and below retirement (around 65 years) that are participating workers, that is people actively employed or seeking employment. People not counted under labour force are students, retired persons, and stay-at home people, people in prisons, permanently disabled persons and discouraged workers.

h. Work: Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time, full time, or unpaid work in a farm, family enterprise or in any other economic activity.

i. Worker: All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation or milk production even solely for domestic consumption are also treated as workers.

j. Main Workers: Those workers who had worked for the major part of the reference period (i.e. 6 months or more in the case of a year) are termed as Main Workers.

k. Marginal Workers: Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers

l. Work participation rate: The work participation rate is the ratio between the labour force and the overall size of their cohort (national population of the same age range). In the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

3.13.5 Demographic Profile of the Study Area

The proposed **Revamp of INDMAX unit at Guwahati Refinery Guwahati Assam** project covers **25** major villages of Kamrup District in the state of Assam. A study was under taken with respect to demography, occupational pattern, literacy rate and other important socio-economic indicators of these districts to reveal the socio-economic structure of the entire project area.

3.13.5.1 Population

The total population of study area is **2253151** the percentages of male & female population are **51.70% & 48.30%** respectively. Breakup of the population for male and female is given in following **Table 38**- consisting of gender-wise details of population as per census data 2011.

3.13.5.2 Social Structure

The Schedule Caste (SC) population within the study area is **7.12%** of the total population with **51.26%** Male and **48.74 %** are female.

The Schedule Caste (SC) population within the study area is **7.12 %** of the total population with a sex ratio of **950** female/1000males. No Schedule Tribe (ST) population in the study area. Breakup of the population for male and female is given in following **Table 37**.

3.13.5.3 Literacy

The total number of literate within the study area is **1824673** which are **80.98**% of total population. Male literacy rate of the study area is **53.57**% and female literacy rate is **46.43%.** Detailed status of literacy is given below in **Table 37**.

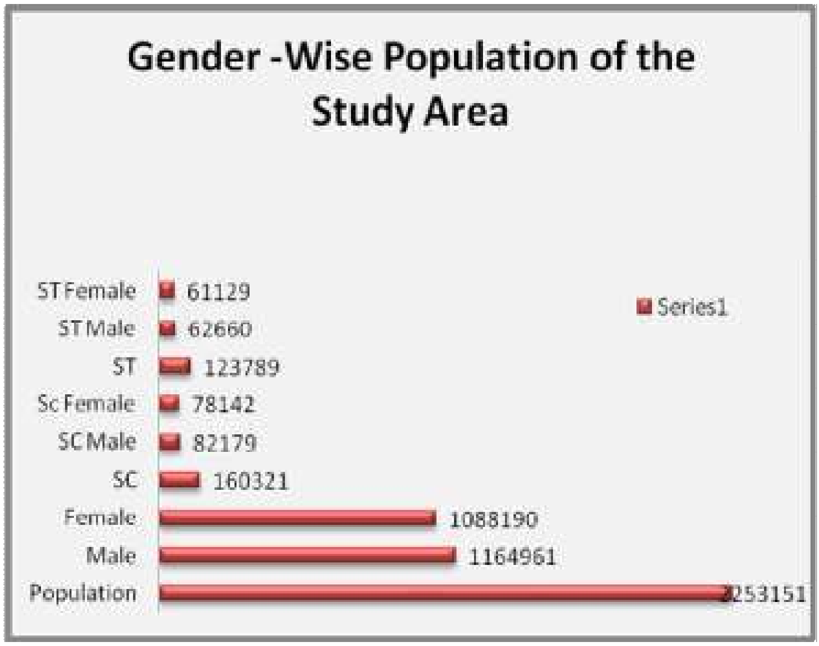
Table 36: Village-wise Demographic Profile of the study area

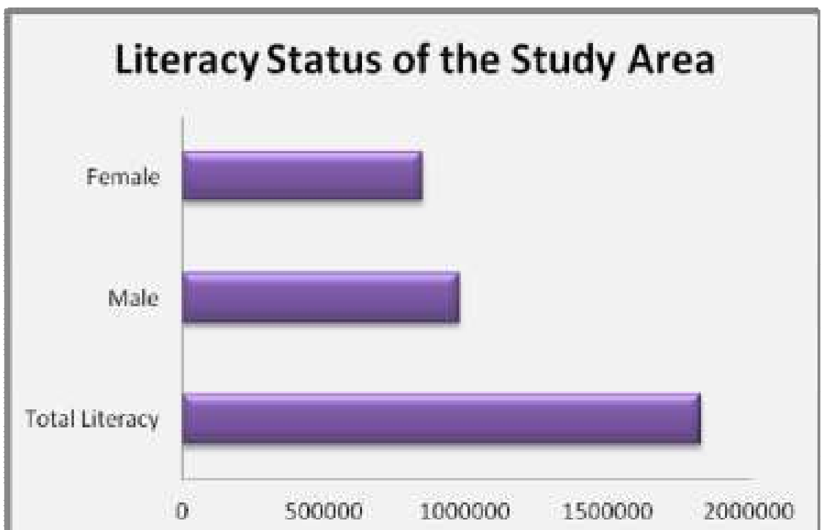
S.No.	Village	Total Population	Male	Female	Sex Ratio	Total SC Population	SC Male	SC Female	Total ST Population	ST	ST Female	Total	Lit.	Lit.
1.	Kamrup Urban	1253938	647585	606353	936	101789	52106	49683	75121	37902	37219	1001191	537227	463964
2.	Guwahati Urban	433771	224424	209347	933	30514	15526	14988	16065	8232	7833	359580	192052	167528
3.	Dispur Urban	534872	277263	257609	929	25905	13473	12432	28169	14292	13877	442675	236341	206334
4.	Tintukura N.C.	199	89	110	1236	45	24	21	0	0	0	139	66	73
5.	Kharghuli	1420	702	718	1023	118	60	58	239	119	120	1052	550	502
6.	Amseng	3979	2094	1885	900	102	50	52	99	53	46	2689	1555	1134
7.	Bamunkhat N.C	500	257	243	946	4	1	3	7	4	3	139	85	54
8.	Amseng N.C.	1545	794	751	946	8	4	4	88	45	43	1015	571	444
9.	Bozra N.C.	520	268	252	940	0	0	0	6	4	2	301	173	128
10.	Kamarkuchi	1725	876	849	969	6	4	2	66	32	34	1324	719	605
11.	Kharghuli N.C.	1251	654	597	913	5	2	3	385	199	186	486	317	169
12.	Panikhaiti	3817	1956	1861	951	930	458	472	501	255	246	2519	1403	1116
13.	Khankar	649	329	320	973	8	5	3	92	46	46	389	214	175
14.	Hojobari	1097	559	538	962	195	99	96	325	168	157	683	376	307
15.	Barchapahi	25	15	10	667	10	7	3	0	0	0	7	6	1
16.	Tatimara	1794	889	905	1018	91	48	43	61	33	28	1426	754	672
17.	Thakurkuchi Gaon	532	247	285	1154	0	0	0	257	115	142	431	218	213
18.	Thakurbari	145	77	68	883	0	0	0	4	3	1	104	59	45
19.	Bonda	4210	2175	2035	936	132	69	63	596	299	297	3443	1861	1582
20.	2 No. Bonda	1263	668	595	891	93	49	44	282	143	139	946	533	413
21.	Thakurkuchi N.C.	277	140	137	979	0	0	0	32	18	14	204	115	89
22.	Khankar N.C.	932	454	478	1053	6	4	2	790	378	412	479	280	199
23.	Kalitakuchi N.C.	1728	916	812	886	142	73	69	24	15	9	1270	733	537
24.	No.1 Bonda Grant	2179	1127	1052	933	201	108	93	561	295	266	1608	886	722

S.No.	Village	Total Population	Male	Female	Sex Ratio	Total SC Population	SC Male	SC Female	Total ST Population	ST	ST Female	Total	Lit.	Lit.
25.	No.2 Bonda Grant	783	403	380	943	17	9	8	19	10	9	573	321	252
	Total	**2253151**	**1164961**	**1088190**	**934**	**160321**	**82179**	**78142**	**123789**	**62660**	**61129**	**1824673**	**977415**	**847258**

(Source: As per Census 2011 – Assam)

Figure 19: Village-wise Demographic Profile of the study area





	Total Literacy	Male	Female
Series1	1824673	977415	847258

3.13.6 Occupation Pattern

Laborers, household workers and other workers: The details of these groups are discussed given below in **Table 38,** and represented in the form of a bar chart as given in **Figure No.19.**

The occupational structure of the population in the study area has been studied with reference to the total workers and non-workers. Further total workers grouped into two categories main workers and marginal workers. Main workers have been grouped into four categories namely: Cultivators, agricultural, household workers, & other Workers.

3.13.6.1 Total workers

Work is defined as participation in any economically productive activity with or without compensation, wage. Such participation may be physical and/ or mental in nature. Work involves not only actual work but also include supervision and direction of work. It even includes part time help or unpaid work on farm, family enterprise or its economic activity. All persons engaged in 'work' as defined above are workers.

The number of total workers in the study area is **880256** which are **39.07%** of total population. Out of which **76.93%** is male and only **23.07%** is female. Total workers further divided into main workers and marginal workers.

3.13.6.2 Main workers

Those workers who had worked for the major part of the reference period (i.e. 6 months or more) are term main workers. Total number of main workers in the study area is **750894** which are **85.30%** of total workers and **33.33 %** of total population.

3.13.6.3 Marginal Workers

The marginal workers are those workers, who are engaged in some work for a period of less than six months, during the reference year prior to the census survey. Total number of marginal workers in study area is 129362 which is approx. 14.70% of the total workers.

3.13.6.4 Cultivators

A person is classified as cultivator if he or she is engaged in cultivation of land own or from government or held from private persons or institutions for payment in money, kind or share. Cultivation work includes effective supervision or direction in cultivation. A person who has given out her/his land to another person or institution(s) for cultivation for money, kind or share of crop and who does not even supervise or direct cultivation process is not treated as cultivator. Similarly, a person working on another person's land for wages in cash or kind or combination of both is not treated as cultivator.

Total cultivators in study area are **23350** out of which **83.83%** is male and **16.17%** is female.

3.13.6.5 Household Worker

Persons working in others household for wages are treated as household worker .the total workers of this category are about **13654** (**1.55%** of total workers) in which **69.25%** are male and **30.75%** are female.

3.13.6.6 Non Workers

The non-workers include those engaged in unpaid household duties, students, retired persons, dependants, beggars etc. The total number of non-workers population is **1372895** which are **60.93%** of the total population. Out of which **35.53%** is male and **64.47%** is female.

3.13.6.7 Agricultural Laborers

Persons working on the land of others for wages or share in the yield have been treated as agricultural laborers. The total workers of this category are about 11038 in which 71.75% are male and 28.25% are female.

3.13.6.8 Other Workers

All workers, i.e., those who have been engaged in some economic activity during the last one-year are other workers. The type of workers that come under this category is government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trading, transport, banking, mining, construction, political or social work, priests, entertainment artist, etc. In effect, all workers except cultivators or agricultural laborers or household industry workers are other workers. The total workers of this category are about **702852** (**79.85%** of total workers) in which **81.27%** are male and **18.73%** are female.

Table 37: Occupational Pattern of the study area

S. No.	Particulars	Number of Workers in the study area			Proportion (%)
		Total	Male	Female	
1.	**Total Workers**	880256	677156	203100	29.99
2.	**Main Workers**	750894	608124	142770	23.48
3.	**Marginal Worker**	129362	69032	60330	87.39
4.	**Cultivators**	23350	19574	3776	19.29

5.	**Agricultural Labour**	11038	7920	3118	39.37
6.	**Household Worker**	13654	9455	4199	44.41
7.	**Other Worker**	702852	571175	131677	23.05
8.	**Non-workers**	1372895	487805	885090	181.44
Total		**3884301**	**2450241**	**1434060**	**58.53**

(Source: As per Census 2011 – Assam)

Figure 20: Occupational Pattern of study area

Table 38: Village Wise Occupational Structure of the Study Area

S.No	Village	Total Population	Occupational Structure							
			Total Worker	Main Worker	Marginal Worker	Non Worker	Cultivators	Agricultural Labour	Household Worker	Other Worker
1.	Kamrup Urban	1253938	490932	413154	77778	763006	20677	8259	7973	376245
2.	Guwahati Urban	433771	169336	146944	22392	264435	736	910	2457	142841
3.	Dispur Urban	534872	209034	181875	27159	325838	1130	862	3068	176815
4.	Tintukura N.C.	199	66	60	6	133	10	0	1	49
5.	Kharghuli	1420	444	416	28	976	16	2	0	398
6.	Amseng	3979	1189	739	450	2790	27	9	11	692
7.	Bamunkhat N.C	500	208	195	13	292	4	6	1	184
8.	Amseng N.C.	1545	470	419	51	1075	4	3	2	410
9.	Bozra N.C.	520	166	163	3	354	0	0	0	163
10.	Kamarkuchi	1725	780	457	323	945	118	59	32	248
11.	Kharghuli N.C.	1251	614	584	30	637	135	407	1	41
12.	Panikhaiti	3817	1380	1275	105	2437	109	447	9	710
13.	Khankar	649	238	237	1	411	26	7	1	203
14.	Hojobari	1097	424	356	68	673	24	10	0	322
15.	Barchapahi	25	12	12	0	13	0	0	0	12
16.	Tatimara	1794	594	566	28	1200	48	8	0	510
17.	Thakurkuchi Gaon	532	154	145	9	378	93	2	0	50
18.	2 No. Thakurbari	145	46	43	3	99	15	1	0	27
19.	Bonda	4210	1424	1254	170	2786	41	15	14	1184
20.	2 No. Bonda	1263	467	419	48	796	8	3	2	406
21.	Thakurkuchi N.C.	277	59	56	3	218	47	0	0	9
22.	Khankar N.C.	932	401	240	161	531	7	14	0	219

23.	Kalitakuchi N.C.	1728	542	436	106	1186	10	2	12	412
24.	No.1 Bonda Grant	2179	950	542	408	1229	33	5	68	436
25.	No.2 Bonda Grant	783	326	307	19	457	32	7	2	266
TOTAL		**2253151**	**880256**	**750894**	**129362**	**1372895**	**23350**	**11038**	**13654**	**702852**

(Source: As per Census 2011 – Assam)

3.13.7 Infrastructural Facilities And Amenities In The Study Area

A review of infra structural facilities and amenities existing in the area has been done on the basis of the information given in census Data of 2011.Infra structural facilities and amenities like education, Health, Drinking Water, Electrification. And transport and communication network are though existent yet their number is not lucrative.

3.13.7.1 Medical Facilities

According to the village Directory, Census Data of **2011**, there are **6** Allopathic Dispensaries, **2** Ayurvedic Dispensaries, **5** PHC, **6** PHSC and **16** Private Subsidized Medical Practitioners in the Study area. The status of study area is given in **Table 40**.

3.13.7.2 Educational Facilities

In the **25** villages within the study area, there are **33** Primary / elementary school, **16** Middle schools, **15** Secondary School/ Senior Secondary School. **5** College, there are no training school fund in the study area. The educational facilities within the study area are presented in Table no.**34.**

3.13.7.3 Drinking Water

As per the census Data of 2011, the entire village in the study area has one of other Source of drinking water. The major source of drinking water in the study area is **32** hand pump (**25villages**) followed by **37** tube well **25**, villages. **25** villages have **37** tap water facilities. During summer, the major source of drinking water is **32** hand pump **25** villages. The numbers of wells, hand pumps, tube-wells, River, Canal, and tap water supply in the study area are shown in Table no.**40** and bar **Figure no.21 and 22**.

Table 39: Village Wise Public Amenities of the Study Area

Village	Total Population	Amenities of the Study Area																	
		Education Facilities					Health Facilities							Water Facilities					
		Primary School	Middle School	Secondary School	Senior Secondary	College	Allopathic Dispensary	Ayurvedic Dispensary	Maternity & C W C	PHC	PHSC	FWC	RPMP	Tap water	Well water	Hand pump	Tube well	River	Canal
Kamrup Urban	1253938	3	3	2	2	2	2	1	1	2	3	1	10	2	2	2	2	2	2
Guwahati Urban	433771	5	5	3	2	2	3	1	-	2	2	1	4	2	2	2	2	2	2
Dispur Urban	534872	2	1	1	1	1	1	-	-	1	1		2	1	1	1	2	2	2
Tintukura N.C.	199	1	-	-	-	-	-	-	-	-	-	-	-		1	1	2	2	2
Kharghuli	1420	-	-	-	-	-	-	-	-	-	-	-	-	2	2	1	1	2	2
Amseng	3979	-	-	1	1	-	-	-	-	-	-	-	-	2	2	1	1	2	2
Bamunkhat N.C	500	2	-	-	-	-	-	-	-	-	-	-	-	2	2	1	1	1	2
Amseng N.C.	1545	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1	1	1	2
Bozra N.C.	520	2		-	-	-	-	-	-	-	-	-	-	2	2	1	1	2	2
Kamarkuchi	1725	1	2	-	-	-	-	-	-	-	-	-	-	1		1	1	1	2
Kharghuli N.C.	1251	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	2
Panikhaiti	3817	1	-	-	-	-	-	-	-	-	-	-	-	1	2	2	1	1	2
Khankar	649	1	-	-	-	-	-	-	-	-	-	-	-	1	2	2	1	2	2
Hojobari	1097	2	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2
Barchapahi	25	1	1	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2
Tatimara	1794	-	-	-	-	-	-	-	-	-	-	-	-		2	2	2	2	2

Thakurkuchi Gaon	532	1	1	-	-	-	-	-	-	-	-	-	-	1	1	1	2	2	2
2 No. Thakurbari	145	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	1	2
Bonda	4210	1	1	-	-	-	-	-	-	-	-	-	-	2	1	1	1	1	2
2 No. Bonda	1263	1	-	-	-	-	-	-	-	-	-	-	-	2	1	1	1	2	2
Thakurkuchi N.C.	277	1	-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	2	2
Khankar N.C.	932	1	-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	1	2
Kalitakuchi N.C.	1728	1	-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	1	2
No.1 Bonda Grant	2179	1	-	-	-	-	-	-	-	-	-	-	-	2	1	1	1	2	2
No.2 Bonda Grant	783	1	-	-	-	-	-	-	-	-	-	-	-	2	1	1	1	2	2
Total	**2253151**	**33**	**16**	**8**	**7**	**5**	**6**	**2**	**1**	**5**	**6**	**2**	**16**	**37**	**36**	**32**	**37**	**41**	**50**

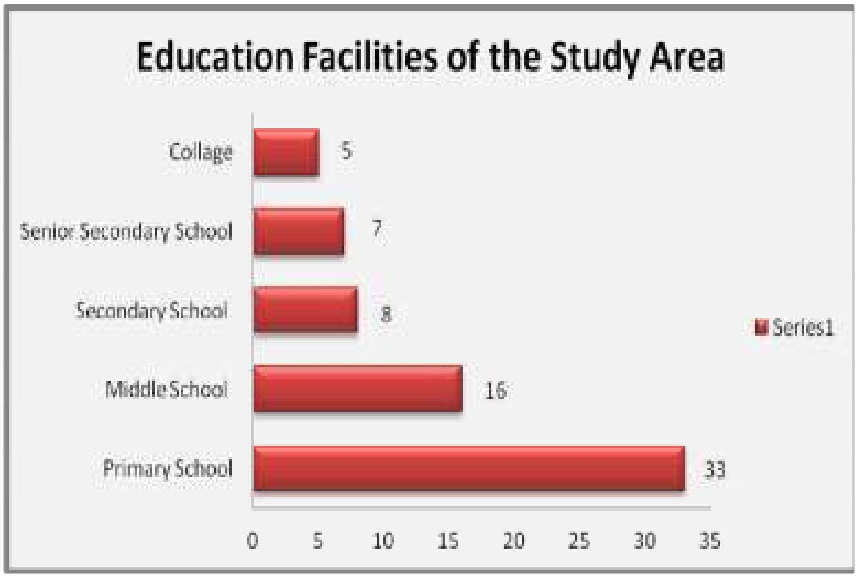


Figure 21: Public Amenities of the study area

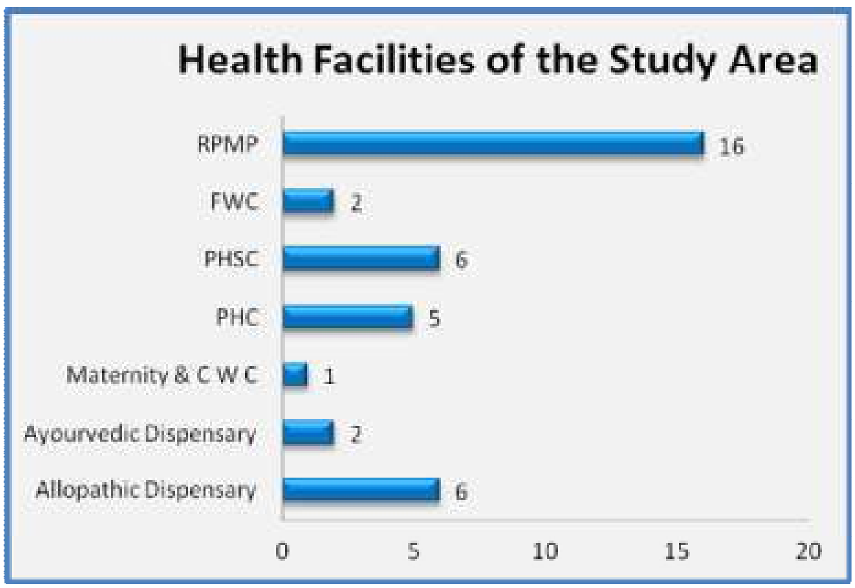


Figure 22: Public Amenities of the study area

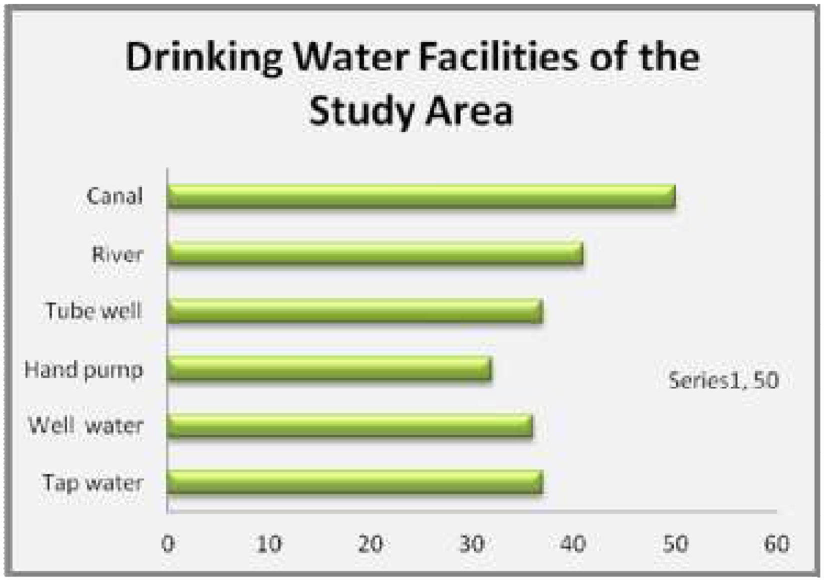


Figure 23: Drinking Water Facilities of the Study Area

3.13.8 Socioeconomic Environment

The Socio Economic Impact Assessment is the systematic analysis used during EIA to identify and evaluate the potential socio-economic and cultural impacts of a proposed development on the lives and circumstances of people, their families and their communities. It can identify and distinguish numerous measurable impacts of a proposed development but not every impact may be significant. The populations who are impacted either directly or indirectly have a say whether the impacts are significant or not.

CHAPTER-4:
ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

CHAPTER-4 : ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 Impact Assessment Methodology

4.1.1 Introduction

Based on the project details and the baseline environmental status, potential impacts as a result of the revamp IOCL refinery project have been identified. This Chapter addresses the basic concepts and methodological approach for conducting a scientifically based analysis of the potential impacts likely to accrue as a result of the proposed project. The Environmental Impact Assessment (EIA) for quite a few disciplines is subjective in nature and cannot be quantified. Wherever possible, the impacts have been quantified and otherwise, qualitative assessment has been undertaken. This Chapter deals with the anticipated positive as well as negative impacts due to construction and operation of the proposed project. The construction and operation phase comprises of various activities each of which is likely to have an impact on environment. Thus, it is important to understand and analyze each activity so as to assess its impact on environment.

The basis of Environmental Impact Assessment (EIA) study for a proposed project consists of

- Identification of the factors likely to have impact on the environment,
- Prediction of the likely scenario due to these impacts following the implementation of the project,
- Suggesting ways aimed at mitigation of the impacts.

The inferences drawn for the current project on the above lines are given below. This analysis is used to prepare an Environmental Management Plan (EMP) document (Chapter 10).

The environmental impacts are evaluated by tabulating a list of different activities during the project implementation and their likely impacts on the environmental indices. This allows the identification of cause-effect relationships between specific activities and their impacts. The mitigation measures presently in operation, if any, or are likely to be taken up, are also taken into consideration.

The EIA includes:

- All major activities of the project likely to have impact on the environment,
- The qualitative estimates of the impact of each activity on the environment,
- The mitigation measures already in place to reduce impacts on the environment,

- Additional mitigation measures suggested, wherever feasible,
- The qualitative estimates of the impact of each activity on the environment after implementation of the additional mitigation measures.

The qualitative evaluation of the impacts is done on the basis of the indicators presented below:

No Impact (NI). This indicates that the project activity is unlikely to have any impact on a particular environmental index.

Negligible Adverse Impact (NA)/Negligible Beneficial Impact (NB). It indicates that the proposed activities will have only minor effect, adverse or beneficial, on the environmental parameters concerned. Generally these impacts are of temporary duration (occur intermittently) or are in insignificant quantities. Impacts are not likely to exceed stipulated limits.

Significant Adverse Impact (SA)/Significant Beneficial Impact (SB). In this case, the activities and their environmental impacts are considered to be significantly adverse if they create, or have the potential to generate environmental impacts, which are readily identifiable, tangible, and harmful. Significant beneficial impacts create reasonable positive impact on the environment.

4.1.2 Impact Identification

The activities with potential to cause significant environmental effects (both positive and negative) include:

- Emissions to air
- Effluent discharges
- Solid waste generation
- Land acquisition
- Accidental fuel and oil spills
- Employment generation, etc.

Each of these activities may have impacts on the physical, biological and socio-economic environment of the area. The key potential environmental aspects associated with the proposed project, their effects and mitigation measures are discussed in the following sections.

4.1.3 Environmental Issues In Petroleum Refining

Petroleum refining is one of the largest industries throughout the world and a vital part of the national economy. However, potential environmental hazards associated with refineries have caused increased concern for communities in close proximity to them. Petroleum refineries separate crude oil into a wide array of petroleum products through a series of physical and chemical separation techniques. These techniques include fractionation, cracking, hydrotreating, combination/blending processes, and manufacturing and transport. The refining industry supplies several widely used everyday products including petrol, kerosene, diesel, motor oil, asphalt, and waxes.

Table 40: Environmental Issues

	Environmental Sensitivities													
	Physical			**Biological**			**Socio-Economic**							
Hazard	**Soil and sediment**	**Water Quality**	**Air Quality**	**Flora**	**Fauna**	**Protected Areas**	**Living conditions**	**Economy**	**Existing activities**	**General Health**	**Personnel**	**Archaeology**	**Tourism/Leisure**	**Land Use**
Physical Presence	X			X	X	X	X	X	X		X	X	X	X
Emissions to air			X	X	X	X	X		X	X	X	X	X	
Noise and Vibration			X	X	X	X	X		X	X	X		X	
Effluent discharge	X	X		X	X	X	X		X	X			X	
Solid Waste Disposal	X	X		X	X	X	X		X	X		X	X	X

The process of oil refining involves a series of steps that includes separation and blending of petroleum products. The five major processes are:

➢ **Separation processes**: These processes involve separating the different fractions/ hydrocarbon compounds that make up crude oil based on their boiling point differences. Crude oil generally is composed of the entire range of components that make up gasoline, diesel, oils and waxes. Separation is commonly achieved by using atmospheric and vacuum distillation. Additional processing of these fractions is usually needed to produce final products to be sold within the market.

➢ **Conversion processes**: Cracking, reforming, coking, and visbreaking are conversion processes used to break down large longer chain molecules into smaller ones by heating or using catalysts. These processes allow refineries to break down the heavier oil fractions into other light fractions to increase the fraction of higher demand components such as gasoline, diesel fuels or whatever may be more useful at the time.

➢ **Treating:** Petroleum-treating processes are used to separate the undesirable components and impurities such as sulfur, nitrogen and heavy metals from the products. This involves processes such as hydrotreating, deasphalting, acid gas removal, desalting, hydrodesulfurization, and sweetening.

- **Blending/combination processes:** Refineries use blending/combination processes to create mixtures with the various petroleum fractions to produce a desired final product. An example of this step would be to combine different mixtures of hydrocarbon chains to produce lubricating oils, asphalt, or gasoline with different octane ratings.

- **Auxiliary processes:** Refineries also have other processes and units that are vital to operations by providing power, waste treatment and other utility services. Products from these facilities are usually recycled and used in other processes within the refinery and are also important in regards to minimizing water and air pollution. A few of these units are boilers, wastewater treatment, and cooling towers.

During these processes of converting crude oil into various useful products, petroleum refineries use and generate some amount of chemicals, some of which are present in air emissions, wastewater, or solid wastes. Emissions are mainly created through the combustion of fuels.

The Refineries are thus considered a source of pollutants in areas where they are located and are regulated by a number of environmental laws related to air, land and water. Here is a breakdown of the air, water, and soil hazards posed by refineries:

4.1.4 Air Pollution Hazard

Petroleum refineries are a major source of hazardous and toxic air pollutants such as BTEX compounds (benzene, toluene, ethylbenzene, and xylene). They are also a major source of criteria air pollutants: particulate matter (PM), nitrogen oxides (NOx), carbon monoxide (CO), hydrogen sulfide (H2S), and sulfur dioxide (SO_2). Refineries also release less toxic hydrocarbons and other light volatile fuels and oils. Some of the chemicals released are known or suspected cancer-causing agents, responsible for developmental and reproductive problems. They may also aggravate certain respiratory conditions such as childhood asthma. Along with the possible health effects from exposure to these chemicals, these chemicals may cause worry and fear among residents of surrounding communities. Air emissions can come from a number of sources within a petroleum refinery including: equipment leaks (from valves or other devices); high-temperature combustion processes in the actual burning of fuels for electricity generation; the heating of steam and process fluids; and the transfer of products. Many thousands of pounds of these pollutants are typically emitted into the environment over the course of a year through normal emissions, fugitive releases, accidental releases, or plant upsets.

Indmax is a high severity catalytic cracking process patented by IOC R&D to produce very high yield of light olefins, high octane gasoline from various hydrocarbon fractions viz., and naphtha to resids. Stack emissions detail of Base case and post revamp of INDMAX unit is given in **Table 42**.

Table 41 : Gaseous Effluent from Stack

Component	Units	Limits	Base Case (2012-13 Avrg)	Revamp Case
SPM	mg/Nm^3	100	88	< 57
SOx	mg/Nm^3	1700	125.2	144
NOx	mg/Nm^3	450	110.9	125
CO	ppmv	400	5.1	7.5
Opacity	%	30	27	25

4.1.5 Water Pollution Hazard

Refineries are also potential major contributors to ground water and surface water contamination. Wastewater in refineries may be highly contaminated given the number of sources it can come into contact with during the refinery process (such as equipment leaks and spills and the desalting of crude oil). This contaminated water may be process wastewaters from desalting water from cooling towers, storm water, distillation, or cracking. It may contain oil residuals. This water is recycled through many stages during the refining process and goes through several treatment processes, including a wastewater treatment plant, before being released into surface waters. The wastes discharged into surface waters are subject to state discharge regulations and are regulated under various Regulations. These discharge guidelines limit the amounts of sulfides, ammonia, suspended solids and other compounds that may be present in the wastewater.

4.1.6 Soil Pollution Hazard

Contamination of soils from the refining processes is generally a less significant problem. Natural bacteria that may use the petroleum products as food are often effective at cleaning up petroleum spills and leaks. Many residuals are produced during the refining processes, and some of them are recycled through other stages in the process. Other residuals are collected and disposed of in landfills, or they may be recovered by other facilities.
Soil contamination including some hazardous wastes, spent catalysts or coke dust, tank bottoms, and sludge from the treatment processes can occur from leaks as well as accidents or spills on or off site during the transport process.

4.1.7 Impact Inventory

Based on the above discussion on possible environmental problems from the existing units of the Refinery and the proposed unit, Check Lists have been identified for prediction of impacts and their mitigation as shown in Table 43.

Table 42 : Impact Inventory

Items	Main Check List	Present Situation
Air Quality	Do air pollutants, such as soot and dust (containing heavy metals, such as Ni and V), sulfur oxides (SOx), nitrogen oxides (NOx), and hydrogen sulfide emitted from various sources, such as boilers, furnaces, catalytic converters coking units (thermal cracking units for residual oils), and other ancillary facilities comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards?	Yes No
Water Quality	Do pollutants, such as BOD, COD, oil and grease, phenols, benzene, and heavy metals contained in effluents (including cooling water) from various process units and other ancillary facilities comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's effluent quality standards? Are adequate measures taken to prevent contamination of surface water and groundwater by these effluents?	Yes No Yes
Wastes	Are wastes, such as organic compounds and hazardous wastes containing heavy metals (such as spent catalysts, collected dust, liquid wastes, and sludge) from various process units properly stabilized, treated and disposed of in accordance with the country's standards? Are non-hazardous wastes also properly treated and disposed of in accordance with the country's standards? Are adequate measures taken to prevent contamination of soil and groundwater by leachate from the waste disposal sites?	Yes Yes Yes
Soil Contamination	Has the soil in the project site been contaminated in the past? Are adequate measures taken to prevent soil contamination by leaked materials, such as crude oil, products, and chemical agents?	No Yes
Noise and Vibration	Do noise and vibrations generated by process unit operations comply with the country's standards? Is there a possibility that noise generated by large vehicle traffic for transportation of materials, such as raw materials will cause impacts?	Yes No

Subsidence	In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	NA
Odour	Are there any odor sources, such as hydrogen sulfide and mercaptans originating from crude oil (especially sour oil containing relatively high levels of hydrogen sulfide)? Are adequate odor control measures taken?	No Yes
Protected Areas	Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	No No
Resettlement	Is there any resettlement and rehabilitation needed?	No
Landscape	Is there a possibility that the project will adversely affect the local landscape?	No
Impacts during Construction	Is there a possibility of construction?	No

4.2 Impact to Air Environment

4.2.1 Dispersion modeling of stack emissions

General:

INDMAX is a high severity catalytic cracking process developed by IOC R&D to produce very high yield of light olefins, high octane gasoline from various hydrocarbon fractions. Thus, the main pollutants considered for dispersion modeling are PM, SO_2 and NOx. For both cases i.e existing and revamp. Thus, for the prediction of impact of stack emission from the proposed plant on ambient air quality during its operational phase, dispersion modeling was performed for prediction of incremental ground level concentrations of suspended particulate matter (SPM), SO2and NOx.

Methodology:

For the proposed atmospheric dispersion modelling study, United States Environmental Protection Agency (USEPA) approved and also recommended by the Ministry of Environment and Forests (MoEF), Government of India, regulatory air quality model (ISC) software AERMOD View 8.6 is applied to predict ground level incremental concentrations (GLCs) of concerned critical pollutants. Prior to air quality modelling exercise, meteorological condition during one season over project site is extensively studied. Concentrations are estimated for the critical pollutants assessed over appropriate averaging times (i.e. 8 hours and 24 hours) based on the applicability of the National Ambient Air Quality Standards (NAAQS).

ISC Short-term model:

The Industrial Source Complex Short Term (ISCST3) model is the US EPA's one of the regulatory models for many New Source Review (NSR) and other air permitting applications. The ISCST3 model is based on a steady-state Gaussian plume algorithm, and is applicable for estimating ambient impacts from point, area, and volume sources out to a distance of about 50 kilometers. The ISC Short Term model accepts hourly meteorological data records to define the conditions for plume rise, transport, diffusion, and deposition. The model estimates the concentration value for source and receptor combination for each hour of input meteorology, and calculates user-selected short-term averages.

Meteorology:

Meteorology is the fluid mechanics applied to the atmosphere. Meteorological conditions play an important role in determining existing air quality and environmental conditions. The essential relationship between meteorology and atmospheric dispersion involves the wind in the broadest sense of the term. Wind fluctuations over a very wide range of time and space scales accomplish dispersion and strongly influence other processes associated with them. The characterization of the existing meteorological conditions near a source of pollutants is, therefore, a critical aspect for assessing air quality in the ambient environment. For the rapid air quality impact assessment meteorological data for the desired season/period over the project region are used for air quality modelling. The following subsections describe the prime meteorological parameters during the observation period which govern the dispersion of pollutants.

Wind direction and speed:

Wind direction is reported as the direction from which the wind blows and is based on surface observations. Over the course of a season, wind usually blows in all directions with varying frequencies. Certain direction, which occurs more frequently than others, is known as the prevailing wind direction. Wind speed and direction and their frequency during pre-monsoon season are represented by wind rose diagram. The wind rose denotes a class of diagrams designed to display the distribution of wind direction experienced at a given location over a period of time - long for a climatological record of prevailing winds or short to show wind character for a particular event or purpose. Wind rose summarizes a considerable amount of wind frequency information into a single graphic and shown in **Figure 10 (Chapter 3)** during the monitoring period.

Atmospheric stability:

A measure of the tendency of air to move upward or downward within the atmosphere generates turbulence. The atmosphere may be more or less turbulent at any given time, depending on the amount of incoming solar radiation as well as other factors. There are six defined Pasquill atmospheric stability classes, from A to F, each representing a different degree of turbulence in the atmosphere. When moderate to strong incoming solar radiation heats air near the ground, causing it to rise and generating large eddies, the atmosphere is considered unstable. Unstable conditions are associated with atmospheric stability classes A, B and C. In this stability class air has strong tendency to move up or down, and the atmosphere is more turbulent. When solar radiation is relatively weak or absent, air near the surface has reduced tendency to rise and less turbulence develops. In this case, the atmosphere is considered stable, the wind is weak, and the stability class would be E or F. Stability classes D represents conditions of neutral stability (moderately turbulent). Neutral conditions are associated with relatively strong wind speeds and moderate solar radiation. The frequency of stability classes during the study period is provided in **Table 44.**

Table 43 Frequency of Stability Classes

Stability Class	Frequency (%)
A – Extremely Unstable	23.3
B – Unstable	17.1
C – Slightly Unstable	3.9
D – Neutral	2.0
E – Slightly Stable	10.4
F – Stable	43.3

This data indicates that over the monitoring period, the site exhibits trends of stable atmospheric conditions with 43.3% time during monitoring period. Stable conditions exhibit poor vertical mixing, and low levels of contaminant dispersion. Use of this stability data for modeling purposes will produce higher concentrations of pollutants at a given receptor (i.e. more conservative results).

Mixing height:

Mixing Height (MH) is the vertical extent through which the contaminant plume can be mixed. Forecasting of mixing height is done with the aid of the vertical temperature profile. The MH is a function of stability. In unstable air the MH is higher and in stable air the MH is lower. With a lower MH, there is a smaller volume of air in which the pollutant can be dispersed, resulting in higher concentrations in the ambient environment. There is a seasonal variation of MH. During summer daylight hours, MH can be few thousand feet whereas for winter it can be a few hundred feet. It varies also in the course of a day. It is lowest at night and increases during the day. Secondary information has been used to determine the mixing height over the study region for the study period (April-June, 2014) and it varies from 25-1500 meters (IMD).

Potential air environment impact assessment:

During plant operation phase, emission from the stack attached to Grinding section bag filter, Scrubber system, Granulation and DG set will be expected as the main air pollution sources. F, SO_2, NO_x and PM will be expected as prime criteria air pollutants. Emission Source characteristic used for atmospheric dispersion modeling is provided in the following **Table 45**. In absence of PM_{10} emission limits, SPM emission limit is assumed for modeling purpose.

Table 44 Emission source characteristics

Particulars	Base case	Revamp case
Mass flow rate, kg/hr	13962	16766
Volumetric flow, Nm^3/hr	11169.6	13412.8
Gas temperature. ^0C	470	488
Stack height, m	50	50
Stack ID at top, m	1.5	1.5

Particulars	Base case	Revamp case
Pollutant concn, mg/Nm³, max.		
Particulate matter	88	57
SO_2	125.2	144
NOx	110.9	125
CO	6.375	9.375
Flow rate, m3/h	30399.31	37388.79
Flow rate, m3/s	8.44	10.39
Area of cross section, m2	1.77	1.77
Efflux velocity	4.78	5.87
Emission rate, g/s		
PM	0.27	0.21
SO2	0.39	0.54
NOx	0.34	0.47
CO	0.02	0.03

Based on the modeling result under observed meteorological condition, 24 hours average maximum Ground Level Concentration (GLC) of, SO_2, NO_x and PM, in existing INDMAX unit is averaged over 24 hours, are estimated to be, 0.697,0.625 and 0.49 $\mu g/m^3$ respectively and Based on the modeling result under observed meteorological condition, 24 hours average maximum Ground Level Concentration (GLC) of, SO_2, NO_x and PM, in INDMAX revamp is averaged over 24 hours, are estimated to be, 0.805,0.697and 0.324 $\mu g/m^3$ respectively. Spatial distribution of ground GLCs of SO_2, NO_x and PM due to plant operation on the impact zone area of 10 km x 10 km on modeling grid size of 100 m x 100 m around the INDMAX revamp is shown in **Figures 23 to Figure 28** respectively. Modeling result envisages that incremental ground level concentrations of modeled pollutants due to plant operation are not significant. The resultant concentration of SO_2, NO_x and PM pollutants are expected well within the NAAQS **(Annexure-XII).**

Table 45 Impact due to INDMAX revamp to the AAQ

Component	Units	Limits	Base Case	Revamp Case
SPM	$\mu g/m^3$	100	0.697	0.805
SO_2	$\mu g/m^3$	80	0.625	0.697
NO_x	$\mu g/m^3$	80	0.49	0.324

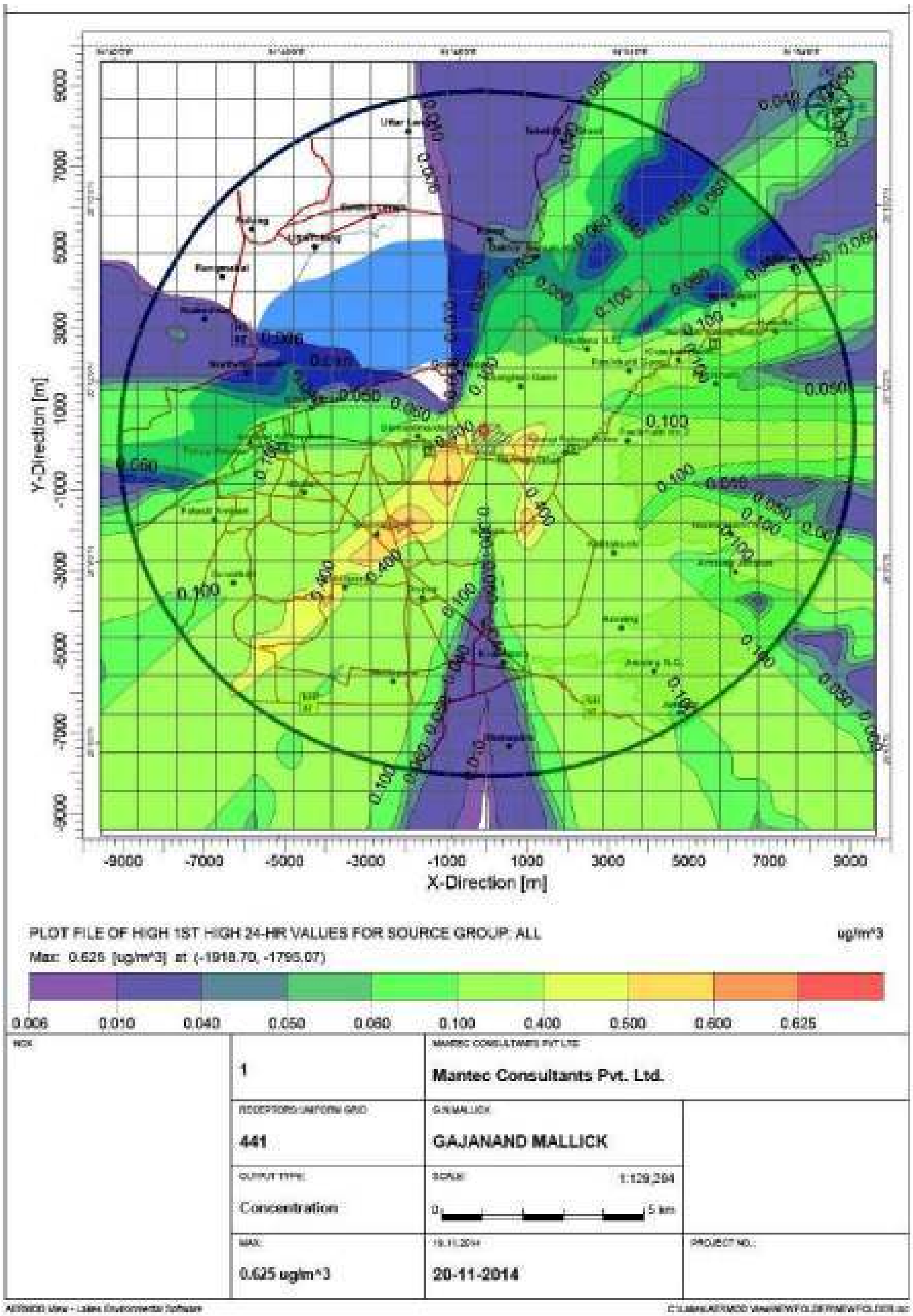


FIGURE 24 SPATIAL DISTRIBUTION OF 24 HR AVG. NO_X CONC. ($\mu g/m^3$) EXISTING INDMAX UNIT

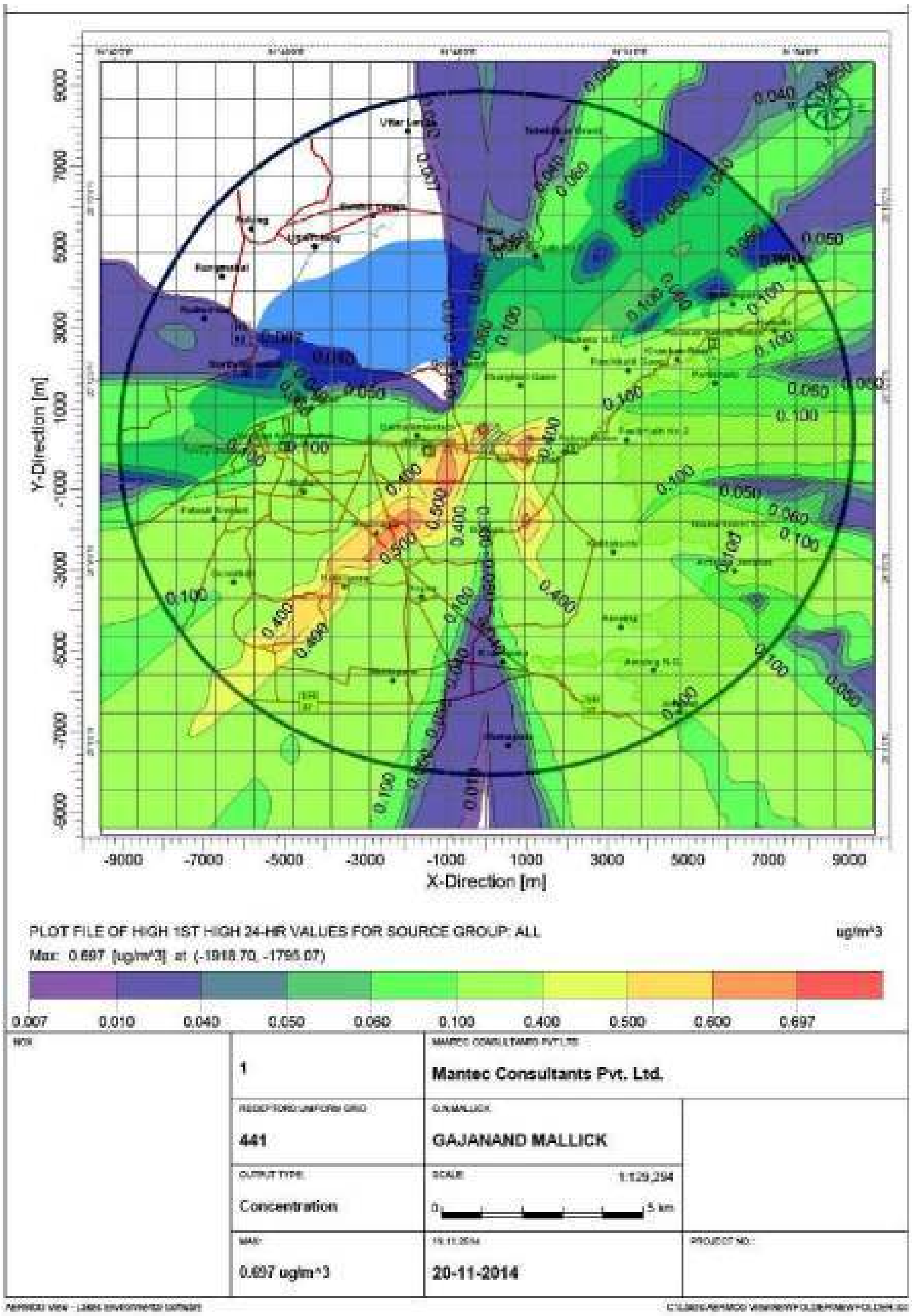


FIGURE 25 SPATIAL DISTRIBUTION OF 24-HR. AVG. NO_X CONC. ($\mu g/m^3$) INDMAX POST REVAMP.

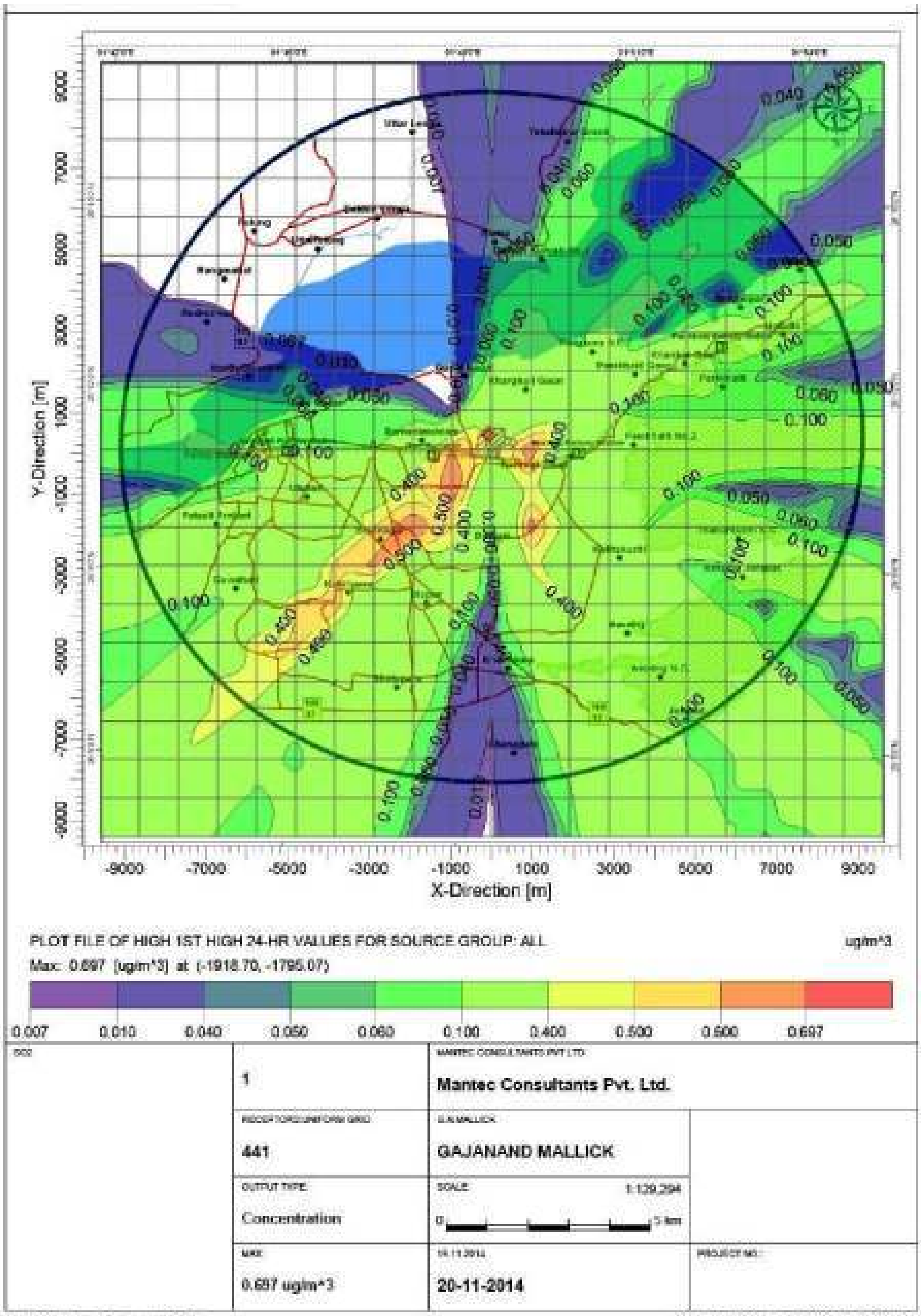


FIGURE 26 SPATIAL DISTRIBUTION OF 24-HR. AVG. SO_2 CONC. ($\mu g/m^3$) EXISTING INDMAX UNIT.

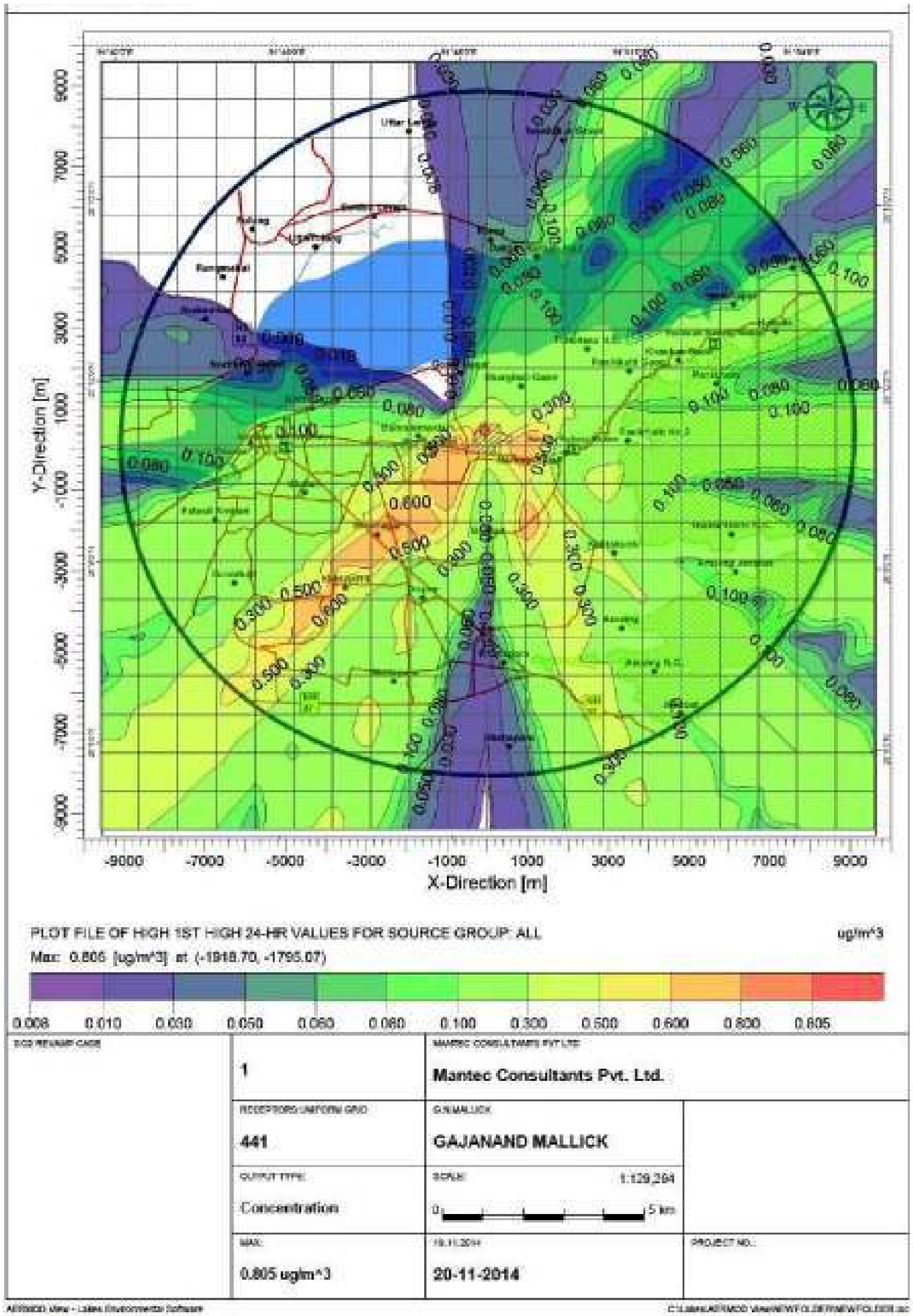


FIGURE 27 SPATIAL DISTRIBUTION OF 24-HR. AVG. SO_2 CONC. (μg/m^3) INDMAX POST REVAMP.

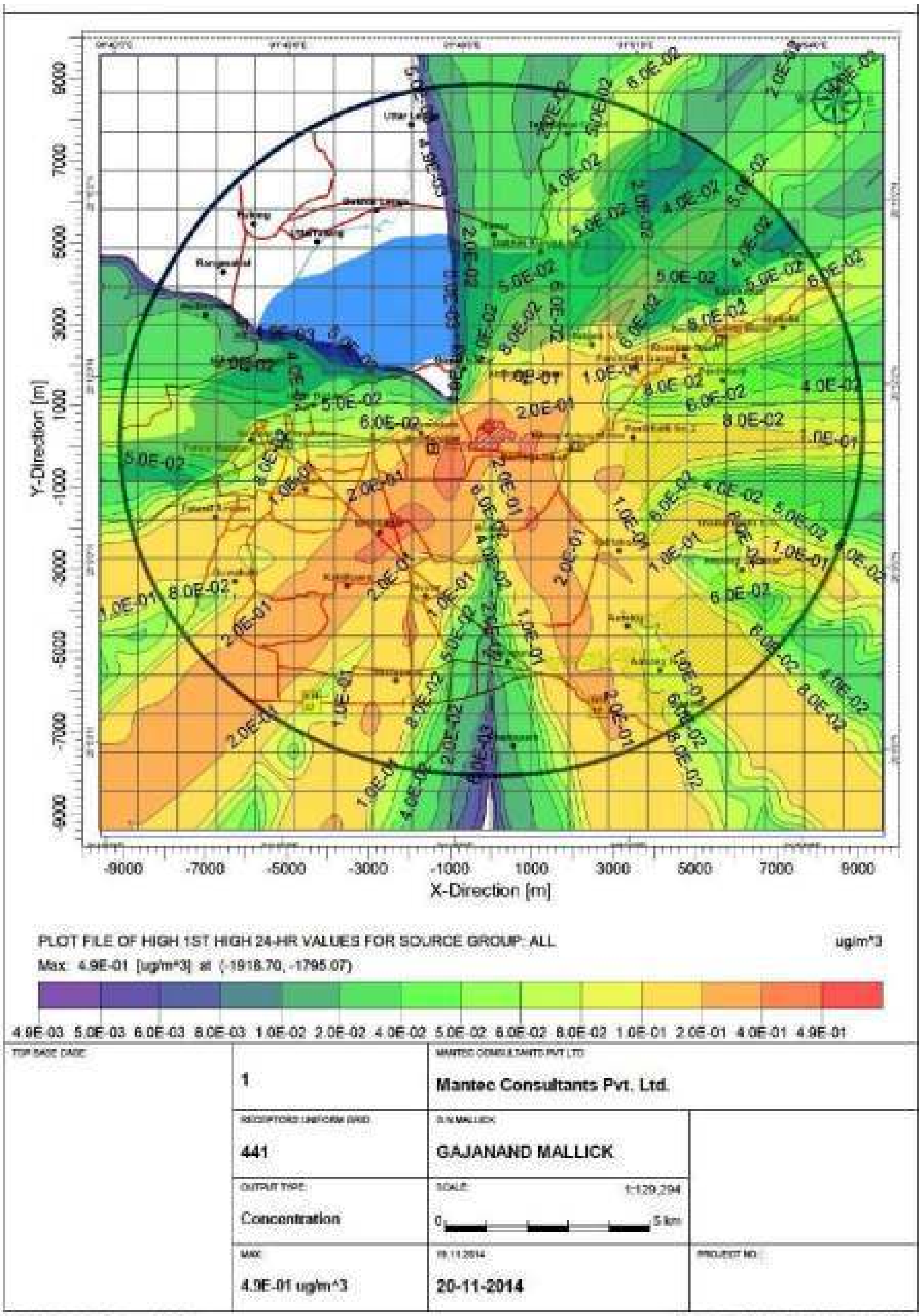


FIGURE 28: SPATIAL DISTRIBUTION OF 24-HR. AVG. TSP CONC. ($\mu g/m^3$) EXISTING INDMAX UNIT.

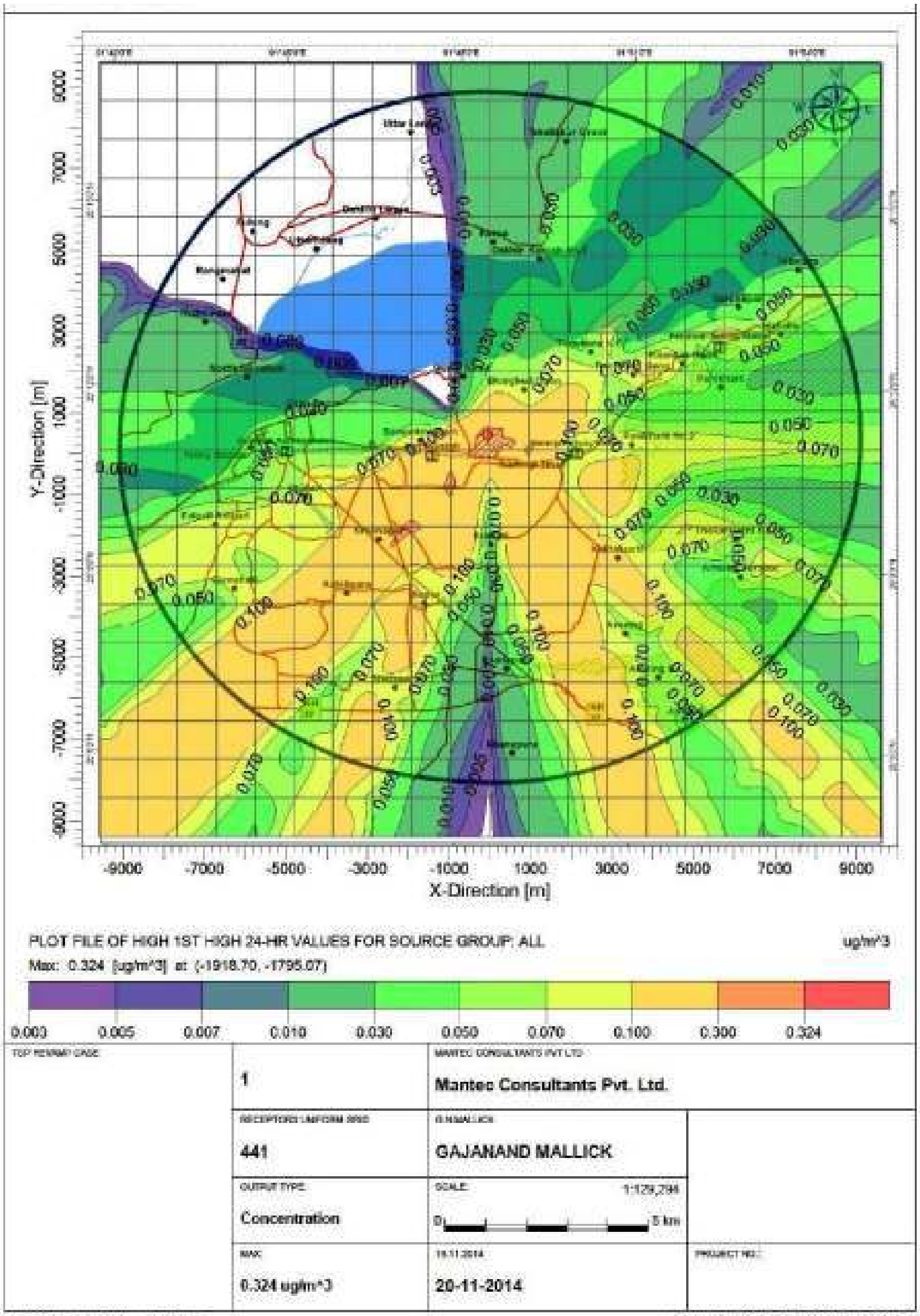


FIGURE 29: SPATIAL DISTRIBUTION OF 24-HR. AVG. TSP CONC. ($\mu g/m^3$) INDMAX POST REVAMP.

4.2.2 Emissions to Air

Careful planning and execution can further minimize the atmospheric emissions and their impacts. Emission of noxious gases to the atmosphere is to be kept below the prescribed norms and this is to be monitored continuously. Other mitigation measures are listed below:
The implementation of the project does not require new land development and therefore vegetation clearing and felling of trees are not involved so that dust emission from such activities will not arise.
To ensure proper dust control, the following measures are required to be adopted:
i) The existing drainage will be used and the natural drainage around the refinery will not be disturbed,
ii) If required, dust monitoring will be undertaken during the construction phase and afterwards,
iii) Only existing roads will be used, and new road construction will be avoided,
iv) Minimum number of vehicles will be used during the construction phase, vehicle speed will be set so as to minimize damage to the topsoil, and chained vehicles will not be used,
v) After the proposed unit begins operation, adequate and appropriate technical measures will be taken to control dust emission from all units of the Plant.

4.2.2.1 Air Pollution Prevention & Control

Online Stack Monitoring

The online stack monitoring system of the Refinery works with the following details in **Table 46**;

Table 46: Online Stack Monitoring System

UNIT	SL NO	TAG NO	SERVICE
BOILER 3 & 4	1	11-SOT-008	SO2
	2	11-NOT-008	NOX
BOILER 5	3	11-SOT-009	SO2
	4	11-NOT-009	NOX
BOILER 6 & 7	5	11-SOT-010	SO2
	6	11-NOT-010	NOX
SRU	7	51A_AI_2101B	Process gas on incinerator stack (SO2)
INDMAX	8	53AT_1603	NOX
HDT	9	49AT_3702A	SOX
	10	49AT_3702B	NOX
HGU	11	48AT_0703B	SOX
	12	48AT_0703A	NOX
CDU	13	01AI002	SO2
	14	01AI 002	NOX
DCU	15	03 AI-602	SO2
	16	03 AI-603	NOX

4.2.2.1.1 Monitoring of Ambient Air Quality

4.2.2.1.1.1 Online AAQM

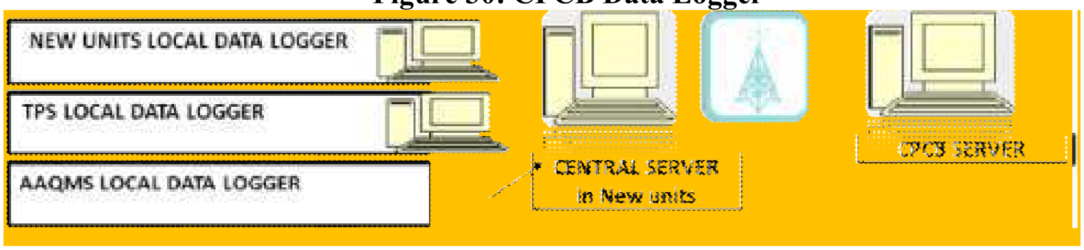
CO, NO_2, SO_2, PM_{10}, NH_3, O_3, and $PM_{2.5}$ Analyzers for Continuous Ambient Air Quality Monitoring installed at CAAQM station in line with National Ambient Air Quality Standards, 2009.

4.2.2.1.1.2 Calibration method

Calibration for SO_2 and NOx analyzers is done by vendor supplied standard gas. Internal zero air is used for zero calibration and span gas of known concentration is used for span calibration.

CPCB connectivity for providing online data to Central Pollution Control Board has been completed for Guwahati Refinery.

Figure 30: CPCB Data Logger



4.2.2.1.1.3 Unit-wise Air Pollution Control Device Details

Low NOx burners provided in the furnaces of CDU, DCU, HDT, HGU & MSQ units. **Table 47** clearly shows that stack emissions post INDMAX Revamp meets all norms so no mitigation measures are required.

4.2.3 Water Environment Impacts

There is an increase of 0.2 m^3/hr in the Refinery's effluent discharge. This additional 0.2 cu-m/hr generated through INDMAX will be treated in Sour water stripper unit and then routed to existing effluent treatment plant. Hence, no major concern is expected. However, the concerns listed in relation to impacts on water quality through discharge of effluents are to be adequately addressed and proper treatment of the effluent should be ensured.

The survey of the water environment in the area reveals that both surface water and ground water sources are free from the usual contaminants. However, the surface water is having bacteriological contamination. The water can be used for drinking and other purposes after appropriate disinfection treatment.

4.2.3.1 Mitigation Measures

The following measures may be taken to minimize potential impacts on surface or ground water:

i) All liquid fuel spills and accidental waste disposal should be avoided and properly cleaned up, if they happen, and

ii) No effluent, storm-water runoff from the Plant, leachates from solid waste dumps, etc., are to be allowed to leave the plant site without treatment.

In order to ensure that the water resources at the project area are not adversely impacted, the following measures should be applied during the project operation:

i) Disturbance to the natural drainage courses should be minimized,

ii) Sewage and wastewater disposal sites should be constantly monitored in a manner that prevents overflows, and should be approved by proper authorities for construction practices, and location,

iii) The performance of the wastewater/effluent treatment facilities is to be continuously evaluated and if any correction is required, the same should be implemented without delay.

iv) Fuels, oils, and other chemicals (e.g., paints, solvents) should be handled and stored in a manner to avoid spills and leakage,

v) Vehicles and other equipment should not be serviced outside of the designated areas.

vi) The fuel storages should have adequate containment area to prevent spills,

vii) Equipment, material and trained personnel should be available to contain and clean up spills,

viii) All spills and leaks should be reported and a record should be maintained,

ix) The emergency response plans should be available for implementation, if required.

4.2.4 Land Environment Impacts

Some amount of wastes in the form of garbage, food scraps, etc. may be generated by the project personnel at site of operation. Care should be taken to minimizing the amount of waste generation and controlling its eventual disposal. All sewage from the plant area will be disposed of in the scientific way without causing any adverse impacts in the Plant site and the surroundings.

4.2.5 Impacts on Ecology

4.2.5.1 Assessment of the Impact of the Proposed Project on Fauna

New stressors within an already fragmented and polluted environment are always of concern in the context of wildlife in that environment. It is therefore important that there is a consideration of the possible impact of the installation of the Guwahati Refinery's proposed INDMAX Unit on the wildlife within the study area.

4.2.5.2 Physical Disturbance

The natural environment within the 10 km buffer set around the Guwahati Refinery has already been noted to be highly fragmented. Any anthropogenic activity that would lead to further fragmentation of habitats in this area is therefore likely to have an adverse effect on the terrestrial and aquatic biota of the area.

As this Unit is planned to be located within the Refinery Complex, and no major land use change envisaged, the 'zone of influence' for the physical disturbance arising from the location of the project is not expected to extend beyond the perimeter walls of the Guwahati Refinery. The impact of physical disturbance arising from implementation of the project, on fauna within the study area, can therefore be expected to be minimal.

4.2.5.3 Eco-toxicological Concerns

Sulphur dioxide has a high vapour pressure (3000mm Hg at 20^0C) and is typically present in the atmosphere in a gaseous phase. Sulphur balance is given in **Table 20**. The primary route of exposure to sulphur dioxide for animals, and humans, is inhalation. Acute exposure to high concentrations of SO_2 results in death in both animals and humans. The primary target for the toxic effects of SO_2 is the respiratory system. Moreover, sulphur dioxide exposures may also act as a co-mutagen and co-carcinogen to link to lung carcinogenic effects (Reed et al., 1986; Meng and Zhang, 1999), and epidemiological studies link sulphur dioxide exposure to respiratory tract disease and lung cancer (Nyberg et al., 2000; Andersson et al., 1998). VOCs in petroleum refinery emissions contain benzene, an aromatic which has been characterized by the US EPA as a 'known' carcinogen for all routes of exposure based upon convincing human evidence, as well as supporting evidence from animal studies (US Environmental Protection Agency 1998). Moreover VOCs and nitrogen oxides (NOx) are the principal precursor emissions that contribute to tropospheric ozone (McKee, 1994) which has serious human health and ecological impacts. Sulphur dioxide and nitrogen oxides in the air also contribute to sulphate and nitrate in particulate matter in the atmosphere and make up a significant portion of overall ambient concentration of fine particle mass concentration (PM2.5) (Reiss et al. 2007). Sulphur dioxide and nitrogen oxides also contribute to acid rain which impacts both terrestrial and aquatic ecosystems.

4.2.5.4 Mitigation Measures

Stack emissions after INDMAX revamp are within acceptable limits; from the air pollution dispersion modeling it is clear that the impact of air pollutant to the surrounding area and Amchang sanctuary is negligible. Thus no mitigation measure required.

4.3 Investigated Environment Impacts

4.3.1 Project Location

There is no adverse impact due to project location because INDMAX unit already exists within the Refinery.

4.3.2 Possible Accidents

Detail of possible accident given in Chapter-7 Risk Analysis report.

4.3.3 Project Design

There is no adverse impact due to project design because INDMAX unit is designed by IOCL R&D Centre Faridabad.

4.4 Project Construction

No. additional constructions due to INDMAX revamp.

4.5 Regualor Operation

No Impact due to regular operation of the plant after revamp.

4.6 Irreversible and Irretrievable Impacts

No irreversible impact due to INDMAX Revamp.

CHAPTER-5:
ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

CHAPTER-5 : ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

The proposed project of INDMAX revamp at IOCL Guwahati Refinery, Assam is an existing INDMAX unit. There will be no change in the technology, only capacity enhancement will take place, therefore, alternative technologies are not envisaged.

CHAPTER-6: ENVIRONMENTAL MONITORING PROGRAMME

CHAPTER-6 : ENVIRONMENTAL MONITORING PROGRAMME

6.1 Introduction

Environmental monitoring programs should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

Environmental monitoring provides feedback about the actual environmental impacts of a project. Monitoring results help judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes.

A monitoring program, backed up by powers to ensure corrective action when the monitoring results show it necessary, is a proven way to ensure effective implementation of mitigation measures. By tracking a project's actual impacts, monitoring reduces the environmental risks associated with that project, and allows for project modifications to be made where required.

6.2 Compliance Monitoring

Compliance monitoring is a commonly practiced form of environmental monitoring. The purpose of compliance monitoring is to ensure that the quality or quantity of an environmental component is not altered by a human activity beyond a specified standard of regulation level.

6.3 Monitoring Schedule

The IOCL Guwahati refinery has a well established monitoring schedule for the already existing INDMAX unit. Hence, this revamp case shall not attract any additional monitoring schedule and parameter.

The refinery is already in complying with all the statutory norms related to environmental concerns of various state and federal agencies i.e. MoEF, CPCB & PCB Assam.

CHAPTER-7:
ADDITIONAL STUDIES

CHAPTER-7 : ADDITIONAL STUDIES

7.1 Public Consultation

As the INDMAX unit is existing in the refinery which is already in operation and hence no public consultation is required.

7.2 Risk Assessment and Disaster Management Plan

IOCL Guwahati Refinery has plans to Revamp INDMAX Unit from 0.1MMTPA to 0.15 MMTPA at their existing refinery complex. INDMAX unit is installed to maximize LPG and light olefin production from heavy petroleum fractions. INDMAX, Indane Maximization Process, developed by Indian Oil Corporation Limited (IOCL) is similar to conventional FCC process. In INDMAX, Coker Gasoline and heavy oils such as RCO, CFO are cracked to more valuable light and middle distillates such as LPG, Gasoline and Diesel.

This document is prepared by Mantec Consultants Pvt. Ltd. for Risk Assessment (RA) of the proposed revamp INDMAX Unit to identify the key hazards and risks. By conducting this type of RA it should be emphasized that the focus is on the major, worst-case, hazards and impacts from surrounding area of these units, essentially in order to prioritise the off-site risks and potential impacts to the public.

7.2.1 Risk Criteria

Individual risks are the key measure of risk acceptability for this type of study, where it is proposed that:

Risks to the public can be considered to be broadly acceptable (or negligible) if below 10^{-6} per year (one in 1 million years). Although risks of up to 10^{-4} per year (1 in 10,000 years) may be considered acceptable *if* shown to be As Low As Reasonably Practicable (ALARP), it is recommended that 10^{-5} per year (1 in 100,000 years) is adopted for this study as the maximum tolerable criterion.

Risks to workers can be considered to be broadly acceptable (or negligible) if below 10^{-5} per year and where risks of up to 10^{-3} per year (1 in 1000 years) may be considered acceptable if ALARP.

Individual risk due to INDMAX revamp unit is below the ALARP regions.

The overall iso-risk contours representing location-specific individual risk (LSIR) for INDMAX unit at Guwahati refinery are given in **Figure-31**.

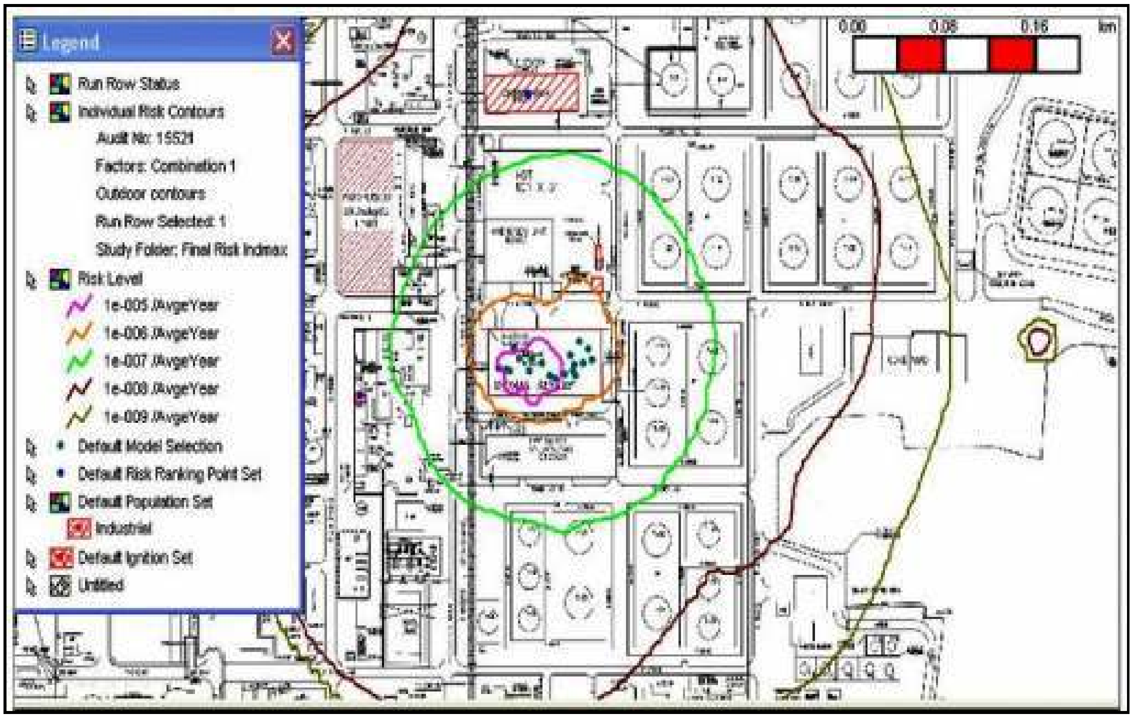


Figure 31: Overall ISO-Risk Contours

The highest location-specific individual risk (LSIR) contour in INDMAX unit at Guwahati refinery is of 1E-05 per year which is within the INDMAX unit.
The maximum LSIR in the units are listed in **Table-48.**

Table 47: Maximum Location Specific Individual Risk (LSIR) at INDMAX unit

S. No.	Unit	Maximum LSIR
1.	HDT/HGU field Operator room	6.57E-08
2.	SRU block field Operator room	2.31E-08
3.	INDMAX Field Operator room	1.14E-07

7.2.2 Individual Risk to Worker at INDMAX Unit (ISIR)

The Location specific individual risk (LSIR) is risk to a person who is standing at that point 365 days a year and 24 hours a day. The personnel in INDMAX unit are expected to work 8 hour shift as well as general shift. The actual risk to a person i.e." Individual Specific Individual Risk" (ISIR) would be far less after accounting for the time fraction a person is expected to spend at a location.

$ISIR_{Area}$ = LSIR x (8/24) $_{(8\ hours\ shift)}$ x (Time spent by and individual/8 hours)

The maximum ISIR in the units are listed in **Table49**.

Table 48: Maximum Individual Specific Individual Risk (ISIR) at INDMAX unit

S. No.	Unit	Maximum ISIR
1.	HDT/HGU field Operator room	2.19E-08
2.	SRU block field Operator room	7.7E-09
3.	INDMAX Field Operator room	3.8E-08

From the results shown above, the maximum individual risk to plant personnel at INDMAX unit is estimated as 3.8E-08 per year.

7.2.3 ALARP Summary & Comparison of Individual Risk with Acceptability Criteria

The objective of this QRA study is to assess the risk levels at INDMAX unit with reference to the defined risk acceptability criteria and recommend measures to reduce the risk level to as low as reasonably practicable(ALARP).

The comparison of maximum individual risk with the risk acceptability criteria is shown in **Figure-32**
From the results shown above, the maximum individual risk to plant personnel at INDMAX unit is estimated as 3.8E-08 per year is lower part of ALARP region.

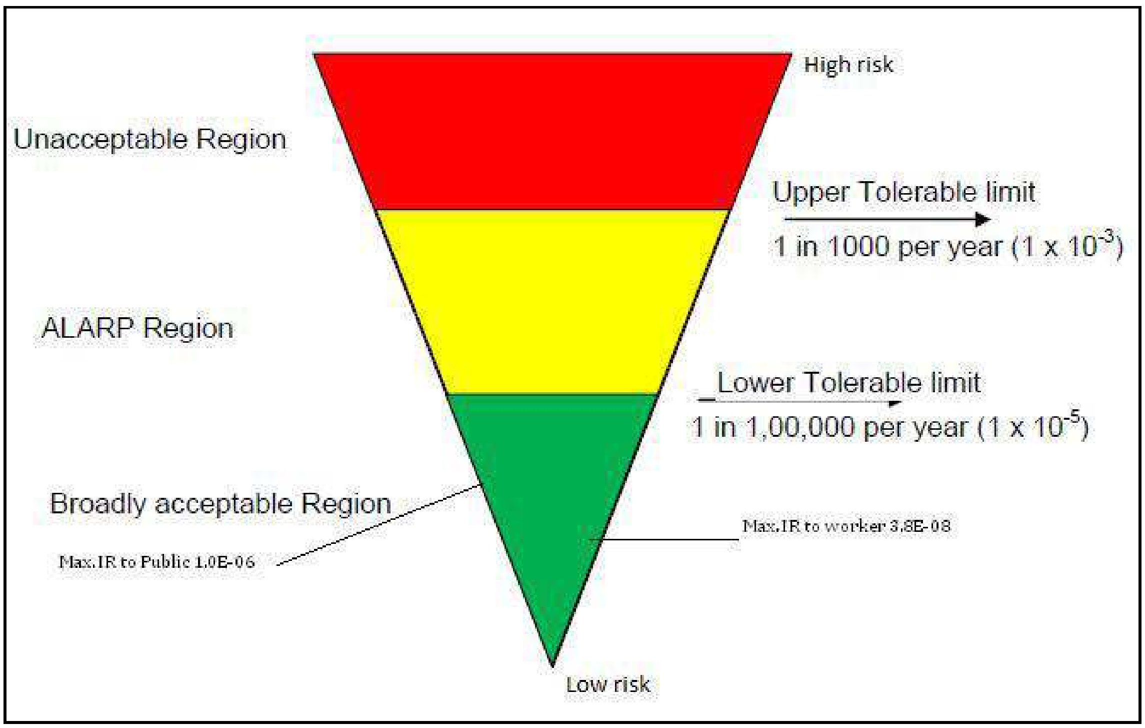


Figure 32: Individual Risk at INDMAX Unit

Societal risk criteria are also proposed, although these should be used as guidance only.
A criterion of 10^{-4} per year is recommended for determining design accidental loads for on-site buildings, i.e. buildings should be designed against the fire and explosion loads that occur with a frequency of 1 in 10,000 years.
The societal risk parameter for INDMAX unit is shown in **Figure-33** in the form of FN curve.
The result from the FN curve show that the Societal risk due to INDMAX Unit is below the ALARP Region which is broadly acceptable or negligible risk.

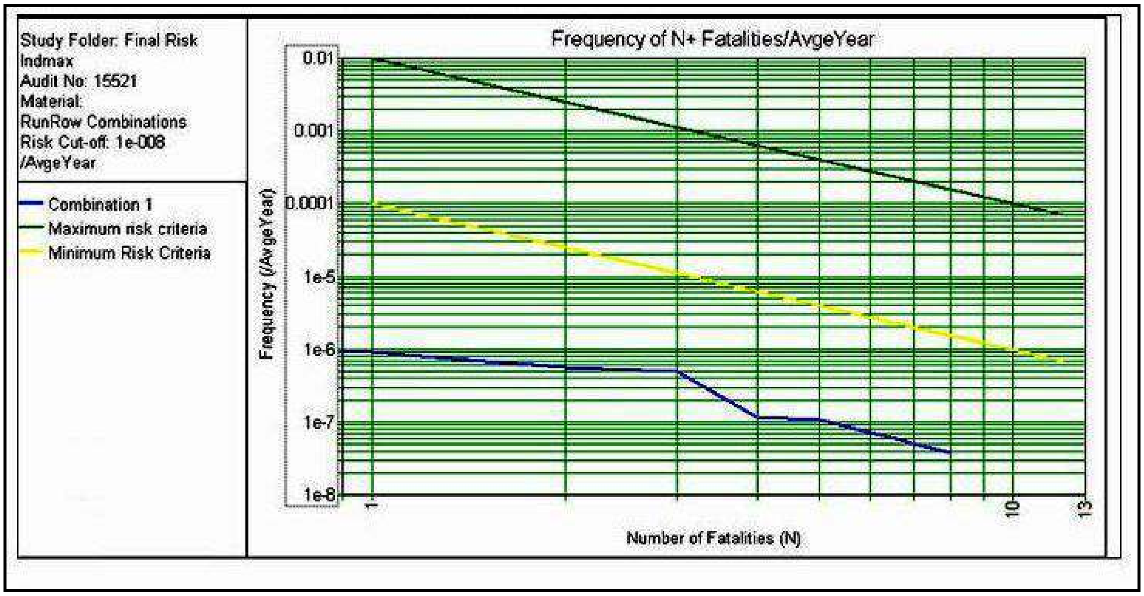


Figure 33: FN Curve for societal Risk at INDMAX unit at Guwahati Refinery

7.2.4 Top risk contributors (Group Risk)

The significant risk contributions from units in INDMAX unit based on result available from PHAST are shown in **Table-50.**

Table 49: Top Risk contributors at INDMAX unit

S.No.	Scenario	Societal risk contribution (%)
1.	Rupture in inlet line to stabilizer/Debutanizer C-06	52.09
2.	Rupture from shell side of TCO CR/C2 Stripper Feed Exchanger(E-06 A/B)	22.34
3.	Leak from shell side of TCO CR/C2 Stripper Feed Exchanger(E-06 A/B)	11.72
4.	Rupture in TCO CR line to main fractionator column C-01	2.22
5.	Leak in discharge line of LPG R/D Pump (P-15 A/B)	1.01

7.2.5 Conclusions and Recommendations

Although the results of this Risk analysis show that the risks to the public are broadly acceptable (or negligible), they will be sensitive to the specific design and/or modeling assumptions used.
The maximum risk to persons working in the INDMAX unit is 3.8x10-8 per year which is below the unacceptable level and is in the lower part of ALARP triangle.
It is observed that the iso-risk contour of 1x10-5 per year is within the INDMAX unit and the risk contour of 1x10-6 per year extended to the adjoining facilities on south east direction which have storage tankage and SRU unit.
The high risk contributors in the INDMAX unit are Stabilizer/Debutanizer and TCO CR/C2 Stripper Feed exchanger (E-06A/B).
The major conclusions and recommendations based on the risk analysis of the identified representative failure scenarios are summarized below:

- The individual risk from all scenarios is found below the ALARP region for Employee and Public for INDMAX unit.
- The INDMAX unit of Guwahati refinery is covered in the process safety management system of Guwahati refinery.
- Mitigate the risk by preventing toxic cloud travelling beyond the plant boundary in South West side but the concentration of Hydrocarbons beyond the boundary is very low, therefore no specific mitigation measures are required for that point.
- Smoking booths existing in non hazardous area.
- Gas detectors are provided at critical locations. Operators are well trained about the fire and gas detection systems.
- Emergency stop of critical equipments are available in control room.
- CCTV coverage with perimeter monitoring available.
- The vehicles entering the refinery should be fitted with spark arrestors.
- Routine checks to be done to ensure and prevent the presence of ignition sources in the immediate vicinity of the refinery (near boundaries).
- Clearly defined escape routes shall be developed for each individual plots and section of the INDMAX unit taking into account the impairment of escape by hazardous releases and sign boards be erected in places to guide personnel in case of an emergency.
- Well defined muster stations in safe locations shall be identified for personnel in case of an emergency.
- Windsocks existing in all prominent locations with clear visibility.
- Identificatio of critical equipments done & inspection methodologies existing for inspection during shutdown.
- The active protection devices like fire water sprinklers and other protective devices shall be tested at regular intervals.

- SOP should be established for clarity of actions to be taken in case of fire/leak emergency.

General Recommendations

1. Nearest tank of INDMAX Unit is T-23, T-15, T-16 and T-28 TANK ON FIRE could affect adjacent tanks in same dyke. Also heat radiations from the tank on fires will slightly affect the INDMAX Unit but the intensity is not so high to cause major damage to the unit. Fixed water sprays system is available on all nearest tanks, irrespective of diameter where inter distances between tanks in a dyke and/or within dykes are not meeting the requirements of OISD-STD-118.

2. Ensure that combustible flammable material is not placed near the Critical instrument of the INDMAX Unit. These could include oil filled cloths, wooden supports, oil buckets etc. these must be put away and the areas kept permanently clean and free from any combustibles. Secondary fire probability would be greatly reduced as a result of these simple but effective measures.

3. Sprinklers and foam pourers provided. Monitors & hydrants located at a distance more than 15 meters.

4. ROSOV and Hydrocarbon detectors to be provided with the nearest tank of the INDMAX unit.

5. Since Refinery operation is being done 24 Hrly. Lighting arrangements are available in line.

A separated risk assessment study is attached as **Annexure-VII** and Disaster Management Plan is attached as **Annexure-VIII.**

7.3 Social Impact Assessment

It is found that there would be positive impact on socio-economic condition in the nearby area as labour will be hired from the local area for daily routine requirement.

7.4 R & R Action Plan

As the INDMAX unit is existing in the refinery which is already in operation and hence no R&R is envisaged.

CHAPTER-8:
PROJECT BENEFITS

CHAPTER-8 : PROJECT BENEFITS

8.1 Project Benefits

The revamp project is being implemented for improvement of revenue and emissions of the refinery. Details of the benefits from the proposed project are given below.

8.2 Increased Processing Capacity & Improved Product Yields

Processing higher quantity of feed will increase the quantity of each product generated in the unit. In addition to that, with the use of the Feed Injectors and Stripper Internals supplied by M/s Lummus Technology Inc, the yields of high-value products like LPG and gasoline are going to increase after revamp.

8.3 Heat Integration

Apart from the increase in processing capacity, two schemes for enhanced heat integration are planned to be implemented during the revamp. Two reboilers which were using High Pressure (HP) steam and Medium Pressure (MP) steam as heating media are being replaced with new reboilers using internal streams as heating media.

1. Benefits from the Project:
   Net total economic benefit estimated from the project is Rs 9.75 Crore/annum. The benefit was estimated based on the average product prices during 2011-14.

CHAPTER-9:
ENVIRONMENTAL COST BENEFIT ANALYSIS

CHAPTER-9 : ENVIRONMENTAL COST BENEFIT ANALYSIS

9.1 Introduction

Environmental cost-benefit analysis, or CBA, refers to the economic appraisal of policies and projects that have the deliberate aim of improving the provision of environmental services or actions that might affect (sometimes adversely) the environment as an indirect consequence. Vital advances have arisen in response to the challenges that environmental problems and environmental policy pose for CBA. Perhaps most notably this includes continuing progress in techniques to value environmental changes. Growing experience of these methods has resulted in, on the one hand, ever greater sophistication in application and, on the other hand, scrutiny regarding their validity and reliability. Distributional concerns have led to a renewal of interest in how appraisals might throw light on questions about equity as well as efficiency, and there have been substantial new insights for discounting costs and benefits in the far-off future. Uncertainty about what is lost when environmental assets are degraded or depleted has resulted in a number of distinct proposals although precaution is the watchword in each. Just as importantly, there is a need to understand when CBA is used in practice and why environmental decisions are often made in a manner apparently inconsistent with cost-benefit thinking.

9.2 Environmental Cost

The proposed facilities for revamp INDMAX unit will cause following environmental costs:

- Negligible impact on ambient air quality due to emission of sulphur dioxide and other air pollutants, which will be well within the specified limits for emission.
- The project will not deteriorate the water quality because no water is discharged nor is any solid matter carried over to the surface or ground water bodies.
- The additional power required for the revamp is too low to add significantly to deterioration of natural resources.

9.3 Environmental Benefits

The proposed project will benefit the environmental in following ways:

- It will facilitate utilization of existing government land without causing change in its designated land use.
- It will facilitate utilization of residue shall prevent additional disposal cost and impact on environment.
- The project may also utilize spent oil generated as waste from various units, thereby eliminating disposal cost and adverse impacts.
- The proposed project will ensure sustained supply of LPG and Gasoline to meet the increasing demand of fuels.

9.4 Conclusion

It may be observed from the above mentioned text that the benefits to the environment exceed the anticipated costs. Therefore, in view of larger number of environmental benefits as compared to nominal costs, the proposed INDMAX revamp project shall provide positive impact on environment.

CHAPTER-10:
ENVIRONMENT MANAGEMENT PLAN

CHAPTER-10 : ENVIRONMENT MANAGEMENT PLAN

10.1 Description of the Administrative Aspects

10.1.1 General

Organizations of all kinds are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the impacts of their activities, products and services on the environment, consistent with their environmental policy and objectives. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures that foster environmental protection, and increased concern expressed by interested parties about environmental matters and sustainable development. IOCL Guwahati Refinery has already implemented the Environmental Management System (ISO 14001:2004) in accordance with the International Standard, and to undertake environmental “reviews” or “audits” to assess its environmental performance.

Specifically, the EMP outlines:

- The technical work program to carry out the EMP, including details of the required tasks and reports, and the necessary staff skills, supplies, and equipment; and
- The planned operation or implementation of the EMP, including a staffing chart and proposed schedules of participation by the various members of the project team, and activities and inputs from various governmental agencies.

For implementation of the EMP, the project proponent is required to establish an Environmental Management Office (EMO). Implementation of the EMP requires that:

- The detailed plans and specifications for the project incorporate all mitigation measures specified in the approved EIA.
- The contract for the project includes all mitigation measures to be implemented. The mitigation measures should be sufficiently detailed that the contractor, in preparing his bid, will be clearly aware that he will be required to comply with these mitigation measures;
- The contractors' performance is duly monitored for compliance with the EMP by competent environmental inspectors under supervision of the EMO.
- On completion of the work, inspection takes place to check that the works, as completed, meet all significant environmental requirements;
- The operation stage monitoring program is implemented as specified in the EMP; and
- There is effective reporting by the EMO, through the Project Management Office, to show that the EMP is being properly managed.

As the unit is under operation a well established management plan is already working. In the case of revamp, the management plan will basically focus on monitoring of additional emissions.

10.1.2 Leadership and Management Commitment

The Project proponent is required to demonstrate its leadership and commitment to the management of Health, Safety and environment (HSE) issues in a top-down approach and highlights the three key elements to demonstrate the commitment of the company:

- Visible leadership,
- Proactive target setting and
- Informed involvement

The Project Proponent must be committed to:

- Pursue the goal of no harm to people;
- Protect the environment;
- Use material and energy efficiently to provide for products and services;
- Develop energy resources, products and services consistent with these aims;
- Publicly report on its performance;
- Play a leading role in promoting best practices in industry;
- Manage health, safety and environment (HSE) matters as any other critical business activity;
- Promote a culture in which all employees share this commitment.

The Project Proponent should aim to:

- Have an HSE performance to be proud of;
- Earn the confidence of customers, shareholders and society at large; and
- Contribute to sustainable development through protection of the environment.

10.2 Policy and Strategic Objectives

10.2.1 Policy

The Project proponent should develop its own Health, Safety and Environment (HSE) Policy, which should be reviewed from time to time to set its strategic objectives in relation to HSE issues. It should have a strong commitment to manage impacts associated with the project by continuously improving the operational performance while protecting the natural environment. It is a commitment, which is in the best interests of the customers, the employees, the shareholders and the society at large. To meet the above commitment, the Project Proponent shall do the following activities:

- Seek to prevent pollution and minimize environmental impact from existing and planned activities. This includes identifying environmental hazards and risks and implementing appropriate controls to ensure that the risks are reduced to a level 'as low as reasonably practicable,
- Recognize the priority of preventing all chemical spills, and maintain contingency arrangements in co-operation with the authorities and emergency services to respond responsibly and appropriately to environmental emergencies,
- Promote a culture of environmental awareness and support environmental training,
- Carry out Environmental Impact Assessments for new projects and significant changes in existing facilities and operations,

- Contribute to sustainable development and support biodiversity,
- Use materials and energy efficiently,
- Report all significant environmental incidents, and take measures to prevent recurrence.
- In association with industry forums, work with the government authorities to help develop environmental policy, regulations and standards and promote best environmental practice in the oil and gas industry,
- Ensure compliance with relevant environmental laws and regulations, industry codes of practice, and other standards and policies voluntarily,
- Set minimum environmental expectations and performance improvement objectives and targets, measure performance, and adjust activities accordingly,
- Conduct internal and external audits and management review to ensure that appropriate resources are in place to carry out this policy, and ensure that policy objectives are being met,
- Require all the contractors to manage environmental matters in line with this policy.

The Project Proponent will always keep in mind and implement the relevant standards laid down by the Ministry of Environment and Forests, Government of India, Central Pollution Control Board, State Pollution Control Board and all other agencies, as well as International Guidelines.

10.2.2 Organization

An appropriate organizational structure should be built up for implementing the above commitments to HSE policy with the following principal features:

- To establish a system for management of HSE risk in the company based on the HSE Policy and all other associated policies for Health, Safety and Environment.
- To establish line of responsibility for operation of the system and detail the roles that all members of the organization are required to play in the day to day operation for developing a fully functioning system with an appropriate Management Structure.
- To address the organization of people and their responsibilities, the allocation of resources, the training and competence of staff and contractors, and the standards and documentation required for sound HSE performance.

This is particularly important in the event of any accident, environmental emergency, etc.

10.3 HSE Audit and Review

10.3.1 Audit Programme

HSE Audit provides with a systematic and independent means to assess the adequacy of the controls in place on risk management. Audits are different from management or supervisor inspections. While both are concerned with the collection of evidence to demonstrate compliance with controls, audits focus on system of controls rather than specific controls on tasks or activities. Each audit will have a specific area of focus, but all will examine a system to gauge whether:

- Minimum HSE requirements and expectations are being met and if there are significant

gaps between policy and performance;
- HSE risks to the business are sufficiently identified;
- Appropriate HSE controls have been set up and are in place; and
- Controls that have been implemented are effective in managing the risks.

A hierarchical system of HSE audits should be organized and kept in operation. The tier category of an audit is to be assigned based on risk. The following three tier audit is envisaged to give the best results:

Tier I Audits are 'one-off' audits that are carried out at a specific location or in relation to a specific activity such as at construction mobilization and contractor qualification, scheduled periodic audits by the line; and prior to start-up of low risk activities;

Tier II Audits are asset, facility or activity (operational or project) specific audits, including selected pre start-up audits. These audits are programmed and carried out to assess the alignment of various sub-systems with the HSE Management System; and the accuracy and currency of any related HSE Cases.

Review Programme
A key component of the HSE Management System is a formal process whereby senior management reviews the system periodically to ensure that:

- It continues to satisfy both the current and future business needs; and
- The system is functioning to continually improve HSE performance.

Ideally, senior management should review the HSE Management System periodically. The purpose of the review is to identify the possible need for changes to the Company's policies and strategic objectives in the light of changing circumstances and the commitment to strive for continual improvement. The review process is documented, with the results recorded to assist in implementing any recommended changes that become apparent through the review. The review process closes the gaps in the HSE Management System with the results of it feeding directly back into the cycle of strategic objective setting and HSE Plan development. Results of the review process also form the basis of the HSE Annual Assurance process.

10.4 Environmental Management Plan

10.4.1 General

Environmental Management Plan (EMP) can be defined as "an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of a project are prevented; and that the positive benefits of the projects are enhanced". EMPs are, therefore, important tools for ensuring that the management actions arising from Environmental Impact Assessment (EIA) processes are clearly defined and implemented through all phases of the project life-cycle. This plan also helps an organization to map its progress toward achieving continual improvements.

10.4.2 Summary of Proposed EMP

The summary of environmental management plan of the proposed project, during its operation phase, is given as…

Environment Management Plan

Air Environment

- **A**ll the emission from the INDMAX Stack is within the limit of MoEF and prediction from the air pollution dispersion modelling. No. additional air management required for the proposed INDMAX Revamp.
- **O**nline flue gas monitor for conti-nuous monitoring of emissions.

Water Environment

- Make-up water requirement of the existing units and facilities is 455 m^3/hour. To meet this requirement, 290 m^3/hour is drawn from River Brahmaputra, and the balance 165 m^3/hour is met through recycle of treated effluents. The proposed revamp of INDMAX Unit will increase the water requirement by 1 m^3/hour, which will be met from treated effluents. Thus, no additional fresh water will be required for the proposed revamp.

Noise Environment

- Operator cabin are acoustic.
- Routine noise monitoring to the existing INDMAX Unit.
- Green belt will be developing in the refinery **to attenuate n**oise.
- Personnel working noisy areas will be provided with ear muffs / plugs - effective noise reduction 10-15 dB(A).
- Vendors of noise

Solid Waste Environment

- Catalyst and Coke fines from Main fractionators' bottom pump strainers during periodical cleaning which will be sent to CPCB authorized vendor.
- A total of 59.4 Tons (maximum) per Annum of e-cat (Equilibrium Catalyst) will be withdrawn from the unit.
- The catalyst withdrawn will be stored in the refinery and used as e-cat as and when required in the unit.

Summary of Environmental Management Plan

10.4.3 Air Environment
All the emission from the stack is within the limit therefore no additional air management required for the INDMAX revamp.

10.4.4 Noise Environment
Due to INDMAX revamp no change in Noise Environment. Adequate safety measures have been incorporated in the proposed plant for control of noise and vibration from different equipment and operations. The control of noise within the plants is through the provision of silencers, hoods, and acoustic walls to the noise generating equipment. According to Regular monitoring of noise it is found that the noise levels at a distance of 1metre from these equipment is not exceed the desirable noise level of 90 dB(A). Proper green belt developed in the Refinery, which would further attenuate noise to bring its level down.
The control rooms provided with acoustic glass walls to protect the operational staff from higher noise level. As the operational staff shall remain within the control rooms for most of the time, they will be exposed to the higher noise levels for very short duration. During the visits to the areas of higher noise levels, the operational and maintenance personnel will use earplugs as a safety measure.

10.4.5 Water Environment

10.4.5.1 Water Conservation/Recycle
Make-up water requirement of the existing units and facilities is 455 m^3/hour. To meet this requirement, 290 m^3/hour is drawn from River Brahmaputra, and the balance 165 m^3/hour is met through recycle of treated effluents. The proposed revamp of INDMAX Unit will increase the water requirement by 1 m^3/hour, which will be met from treated effluents. Thus, no additional fresh water will be required for the proposed revamp.

10.4.5.2 Rainwater harvesting
Rainwater collection system

Rain water harvesting system will be provided for run-off from building roofs and open areas. The rain water will flow be gravity through the storm water drains into the rain water collection tank. The collection tank will be of adequate capacity to facilitate settling of suspended matter. From the collection tank, the water will overflow into the rainwater harvesting pit, lined with pebbles, gravel and coarse sand. Water, free from suspended solids, will enter the ground water table through the slotted pipes for rain water. The rainwater collection tank will be of adequate capacity to avoid any overflow from the harvesting tank.

10.4.6 Solid Waste Management in the Refinery
Two types of solid wastes being generated in Guwahati Refinery are (i) Oily sludge and (ii) Biological sludge. During revamp case, main solid waste will be Catalyst and Coke fines from Main Fractionator Bottom Pump strainers during periodical cleaning. The spent catalyst will be disposed off as per existing practice.

10.4.6.1 Oily Sludge

Oily sludge is generated during the cleaning of Crude oil tanks, Products storage tanks and regular withdrawal of sludge from API separator's bottom. The sludge generated during the cleaning of crude oil tanks, product tanks and API separator bottom is stored at sludge lagoon and subjected to sludge processing to recover slop oil and residual cake. The slop oil recovered is processed in Unit and residual sludge is stored, which is further treated via Bioremediation process being carried out under the aegis of TERI, New Delhi and R&D, IOC.

10.4.6.2 Biological Sludge & Residual oily sludge

Biological sludge is generated in ETP in activated sludge treatment process. Further sludge is also generated from the TPI (oily sludge), DAF (chemical sludge) etc. All type of sludge are mixed and centrifuged. Residual cake sludge from centrifuge is subjected to Bioremediation process for further treatment and the centrate recovered from the centrifuge is taken back in to the ETP process for further processing

Further, the Refinery is also arranging for regular sludge processing so as to avoid sludge accumulation in the refinery premises

Guwahati Refinery has completed the bioremediation of a batch of residual sludge (4320 m3) (< 10% oil content) generated from oily sludge processing in 2012-13. It has also constructed two new HDPE-lined RCC pits for Bioremediation to accelerate the Bioremediation process. The bioremediation is being carried out by M/s TERI, New Delhi.

10.4.6.3 Sludge Management

- No sludge generation is envisaged in this project.

Spent catalyst management

- The catalyst withdrawn will be stored in the refinery and used as e-cat as and when required in the unit. Other solid waste generated from the INDMAX revamp will be sold to CPCB Authorized vendor.

10.4.6.4 E-Waste management

E- Waste management is carried by e-auction and has been disposed off through agencies specified by CPCB following standard guidelines.

10.4.6.5 Kitchen waste management

- 1 no. of OWC (Organic Waste Convertor) installed at Sec-3 Township. Under this, all food waste shall be converted to compost manure, which shall be utilized in garden and other green belt areas. This shall help in eliminating the present unhygienic method of such waste disposal.
- 1 no. of OWC procured for installation at Sec-2 Township.

10.5 Hazards and Effects Management (HEMP)

The Guwahati refinery has well established ERDMP which includes all the Risk and Hazard associated with the INDMAX Unit.

The proposed activities have the potential to harm people and the environment, to cause damage to or loss of assets, to cause financial loss, and to adversely impact the Company's reputation. To address these risks, the company is required to adopt a comprehensive Hazard and Effects Management Process (HEMP) as a structured approach to identifying and managing the hazards and potential effects of all the activities associated with the proposed project.

The HEMP studies (whether big or small) shall include:

- Identification of the major hazards to people and the environment;
- Assessment of the related risks;
- Developing and implementing measures to control these risks;
- Evaluation of the sufficiency of risk reduction;
- Planning to recover from the effects of the hazard if control measures fail; and
- Thorough documentation of the process of the evaluation.

Hazards and effects management is the core of the Health, Safety and Environment Management System (HSEMS).

The expected likelihood of occurrence of the hazard is always to be kept under consideration and a procedure is to be laid down for meeting the eventuality. This exercise is to be repeated for all possible and envisaged hazards identified in the previous chapter in relation to the activities, and then the risks are to be grouped into three different categories as follows:

- High Risk - Intolerable.
- Medium Risk - Tolerable but requires demonstration of the procedure to be followed in case of occurrence.
- Low Risk – Tolerable

  Activities involving High (intolerable) Risk shall not proceed unless all of the following conditions are met:
- It is confirmed that the activity is necessary and there is no feasible alternative;
- There has been a detailed assessment to demonstrate that the controls are suitable, and the risks are reduced to the tolerable level; and
- Senior management has endorsed the decision to proceed with the activity.
- Activities involving Medium (but tolerable) Risk are allowed to proceed only after it can be demonstrated that the risks associated with the activity are managed to the allowable level, with the demonstration being proportional to the risk.

Activities involving Low (tolerable) Risk may proceed in accordance with no additional assessment, but in accordance with normal HSEMS practices.

The Company has to formulate a fundamental response structure to interface with contractors, subcontractors, host government agencies, and non-government organizations that could become involved during emergencies of major magnitude for several reasons:

- It identifies immediate response teams, resources and responsibilities;
- It provides for resources appropriate to the situation; and
- It enables allocation of financial and management requirements appropriate to the situation.

The Company is required to put in place a general Crisis and Emergency Response Procedure (CERP) which encompasses all types of emergencies. The CERP has a comprehensive list and structure of key documents supplying an overview and detailing supporting procedures. Appropriate response teams should be in place before embarking on the activities proposed.

The Crisis and Emergency Response System should consist of:

A Site Control Team (SCT);

i) An Emergency Co-Ordination Team (ECT);
ii) A Crisis and Emergency Management Team (CEMT);
iii) A Crisis Manager;
iv) External Contractors who are to be contacted in case of emergency;
v) Governmental authorities and organizations to be informed and consulted during a crisis,
vi) Prominent NGOs, Experts and Consultants for help and cooperate during any crisis.

10.6 Occupational Health Surveillance Program

According to the WHO Health for All principles and ILO Conventions on Occupational Safety and Health (No. 155) and on Occupational Health Services (No. 161), every worker has the right of access to occupational health and safety services, irrespective of the sector of the economy, size of the company, or type of assignment and occupation. It is estimated that unsafe work conditions is one of the leading causes of death and disability among the working population.

Occupational health aims at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention of adverse health conditions in the work place; the placing and maintenance of workers in an environment adapted to their physiological and psychological capabilities, etc. The ultimate objective of occupational health is a healthy, safe and satisfactory work environment and a healthy, active and productive worker, free from both occupational and non-occupational diseases. The oil and gas industry is potentially more hazardous than many other industries as it has many diverse activities, including processes, operations and materials which can pose risks to health, safety and the environment. As the result of these, workers are exposed to Physical, Chemical, Biological and Psychological hazards that have potential risk to health and wellbeing. The Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008 provides regulation of health and safety in offshore oil and gas exploration, exploitation, production/ drilling and matters connected therewith.

10.7 Health Hazards in Oil & Gas Industry

Virtually all the health hazards common to industry may be present in an oil industry, namely,

- Chemical hazards (toxic, corrosive, irritant and sensitizing substances and possible carcinogens);
- Physical hazards (noise, vibration, various forms of radiation, thermal extremes);
- Biological hazards (food poisoning. Malaria);
- Ergonomic hazards (manual handling activities, workstations, VDUs); and
- Psychosocial hazards associated with the work atmosphere (Isolation, hours of work, tours, shifts, work load and content, fatigue, etc all of which can contribute to psychological stress

The health hazards in a Petroleum Refinery are illustrated in Table 51:

Table 50: Health Hazards in a Petroleum Industry

Employee health effects	Community health effects
Petroleum products	Petroleum products
Metals	Metals
Temperatures (Hot/cold)	Load

Silica/asbestosis	Noise
Noise and vibration	
Solvents	
Treatment Chemicals	

10.8 Occupational Health Survey and Management

Occupational health risk management is a logical and systematic method of identifying, analyzing, assessing, mitigating, monitoring and communicating health risks associated with an activity, function or process in a way that will enable organizations to control health risk. It is an integral part of any management process.

The management system for occupational health provides the framework for the process of identifying hazards, assessing associated risks, taking action and reviewing the outcome. The objective is to prevent occupational diseases and to promote the employee health. In occupational health, the deliverable is the absence of occupational diseases resulting in a healthy and productive worker.
An effective Occupational Health Management System (OH-MS) has the following elements:

Table 51: OHMS Requirements

OH-MS Elements	Requirement
Leadership and Commitment	Commitment of the top management to good OH practices
Policy and Strategic objective	Organization's appreciation of all significant OH hazards for planning, hazard identification, risk assessment and risk control
Organization & resources	Organization of people, resources and documentation for good OH performance
Health Risk Assessment	Identification and evaluation of OH risks for the activities, products and services and development of risk reduction measures
Planning and Implementation	Planning and conduct of work activities including planning for changes and emergency response. Broadly the programs can be classified into Health protection and Health promotion programs
Monitoring and corrective actions	Performance and monitoring of OH activities and corrective action as necessary
Auditing and reviewing	Audit program and procedures for periodic audits to determine and review whether the OH management system conforms to the planned arrangement for OH-MS and commitment to continual improvement

The organization should have a documented OH-MS (strategies and plans of actions) to achieve the objectives. Broadly the programs can be classified into health protection and health promotion programs.

10.9 Health Protection Programs

a) Health risk assessment has been broadly defined as the methodology to predict unwanted health effects from work, other activities and the environment. It consists of

b) Hazard identification, (ii) risk evaluation, (iii) risk control and (iv) risk reduction measures.

c) Health Impact Assessment surveys the potential health risk and benefits to the population with regard to the operations. The Health impact assessment offers an opportunity to indentify health hazards in advance and mitigate any negative effects.

d) Occupational Health Surveillance and Fitness for Task Assessment is a program of periodic medical history and examination, and relevant tests of exposed workers, to ensure that the employee is not harmed by the work they do, or the environment they work. Also health surveillance is required as part of national and local occupational health regulation. Fitness for task assessment is to ensure that the individual working for an organization is able to do so without risk to him and others.

e) Emergency Preparedness and Response. The organization should actively assess potential accident and emergency response needs, develop plans, procedures and processes to cope with them, test its planned responses, and seek to improve the effectiveness of its responses.

10.10 Health Promotion Programs

This aims at promoting the health of employees on identified health issues at work. This includes:

a) Assessment of Risks related to Life Style and Environment. The main aim is to identify key employee health issues and develop programmes to educate for prevention and harm reduction. Where appropriate, these programmes need to be extended beyond the work-force and into the community. This may include HIV, tuberculosis, smoking, obesity, heart disease, malaria and vaccination programmes.

b) Management of ill-health in the Work place. This is achieved by providing access to health care facilities to mitigate the effects of ill health on their ability to work effectively, post illness or injury to facilitate employee rehabilitation and return to work. A system should be in place to provide access to primary, secondary and emergency medical facilities as well as appropriate counseling and employee assistance as and when required.

10.11 Occupational Health Monitoring at Work Place

This will include regular medical examination of the workers as follows:

a) Conduct pre-employment and pre-placement medical examination (baseline medical data) of employees to assess fitness for work, taking into consideration the hazards and risk assessment in the workplace.

b) Determination of the ability to work while wearing the Personal Protective Equipment.

c) Maintain the medical records of employees during the course of employment (periodic) and post termination.

d) Documentation of employee exposure to hazards at workplace.

e) Interpret and explain the results of investigations to the employee and employer and specify what further follow up action is necessary.

f) Analysis of Occupational Diseases & Poisoning and co-relate with Chemical Health Risk Assessment.
g) Investigation of the cause of the Occupational Disease / Poisoning. Visit work place and recommend remedial actions.
h) Notification of Occupational Diseases & Poisoning to employer.
i) Assist in Implementation of Occupational Health Programme in the workplace.
j) Assist in the management of Occupational Diseases & Poisoning including removal from work, treatment, rehabilitation, disability assessment, return to work and / or compensation.
k) Reinforce the value of education/ training in Occupational Health to both employer and employee.
l) Assist in Audit / Evaluation of Occupational Health Programme in the workplace.

10.12 Sustainability Development

10.12.1 Carbon Neutral

As a part of 'Sustainable Development Initiative' to reduce carbon footprint, World Environment Day 2013, 5th June 2013 was made carbon neutral at Guwahati Refinery. A total of 4.01 tons of carbon dioxide was estimated to be generated during the occasion. Carbon dioxide released in the atmosphere to be sequestered by planting 10 tree saplings GR planted 2475 No. of saplings.

As a measure towards sustainability development

- Rain water harvesting schemes being implemented
- 2 no. of training programme conducted on sustainability

10.12.2 Clean Technology

10.12.2.1 Solar Energy

Solar Water Heater

With a view of propagating use of non-conventional energy Solar energy schemes implemented in Guest House, Admin Building and Plant Canteen for heating 2700 LPD of water.(Plant canteen with 1500 LPD capacity of solar collectors (flat plate collectors (FPC)).ADM pantry with 200 LPD capacities of solar flat plate collectors (FPC). Guest House with 500 LPD x 2nos. capacities of solar collectors (flat plate Collectors (FPC)); around 23000 unit power saving per annum.

Solar power lights

Installation of 30 nos. 2 X 11 W CFL Street lights on trial basis within Refinery. A power saving of nearly 80000 KWh per year is envisaged.

Solar Light Pipe

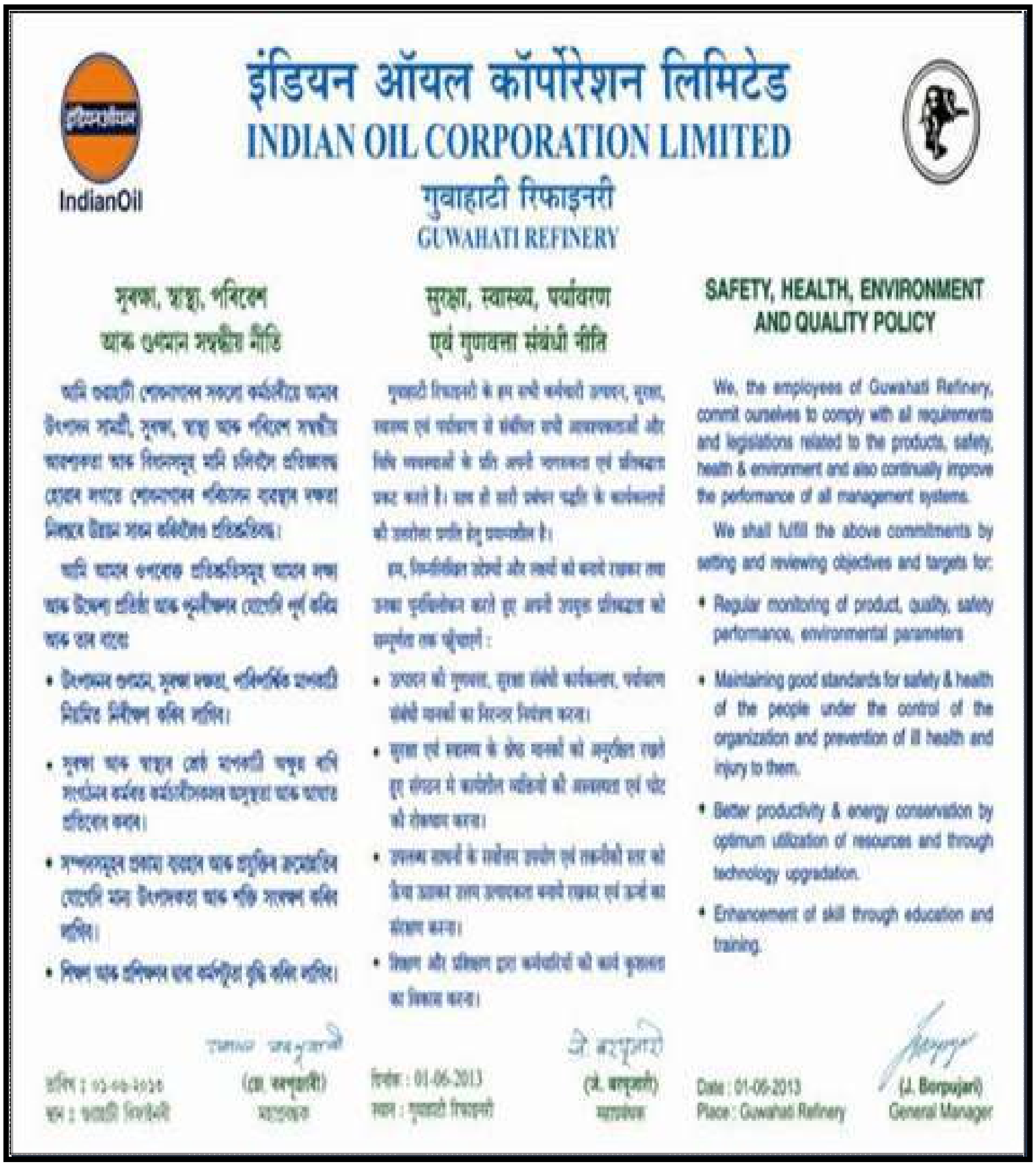
As an initiative towards green energy, Light Pipe installation has been carried out at Electrical workshop. Light Pipe is a green energy initiative of day lighting of big sized sheds, buildings by harvesting sunlight.

10.13 Environment (Protection) Amendment Rules, 2008

- The modernized Effluent Treatment Plant, commissioned in March '07, consisting of primary, secondary and tertiary treatment facilities are running well.
- In line with the New Gazette Notification, Guwahati Refinery is meeting all effluent parameters.
- The Refinery has an online flue gas monitoring instrument in all the stacks to monitor SOx, NOx emissions.
- It has installed four High Volume Samplers at different locations and a Continuous ambient air monitoring station to monitor Ambient Air Quality.
- Noise & Toxic gas surveys are carried out regularly at different locations within the refinery to ensure healthy work environment.

10.14 Environment Health & Safety Policy

The Guwahati unit of IOCL refinery is having a well placed SHE & Quality policy for its employee. A copy of the same is given below:



इंडियन ऑयल कॉर्पोरेशन लिमिटेड

INDIAN OIL CORPORATION LIMITED

IndianOil

गुवाहाटी रिफाइनरी

GUWAHATI REFINERY

सुरक्षा, स्वास्थ्य, पर्यावरण एवं गुणवत्ता संबंधी नीति

SAFETY, HEALTH, ENVIRONMENT AND QUALITY POLICY

We, the employees of Guwahati Refinery, commit ourselves to comply with all requirements and legislations related to the products, safety, health & environment and also continually improve the performance of all management systems.

We shall fulfill the above commitments by setting and reviewing objectives and targets for:

- Regular monitoring of product, quality, safety performance, environmental parameters
- Maintaining good standards for safety & health of the people under the control of the organization and prevention of ill health and injury to them.
- Better productivity & energy conservation by optimum utilization of resources and through technology upgradation.
- Enhancement of skill through education and training.

Date : 01-06-2013

Place : Guwahati Refinery

(J. Borpujari)

General Manager

Figure 34: SHE & Quality Policy

CHAPTER-11:
SUMMARY & CONCLUSION

CHAPTER-11 : SUMMARY & CONCLUSION

11.1 Overall Justification for Implementation of the Project

11.1.1 Project benefits

The revamp project is being implemented for improvement of revenue of the refinery. Details of the economic and environmental benefits from the proposed project are given below.

11.1.2 Increased Processing Capacity & Improved Product Yields

Processing higher quantity of feed will increase the quantity of each product generated in the unit. In addition to that, with the use of the Feed Injectors and Stripper Internals supplied by M/s Lummus Technology Inc, the yields of high-value products like LPG and gasoline are going to increase after revamp.

For example, from the product pattern, gasoline generated in revamp case will be 59.25 TMTPA with INDMAX unit capacity of 150 TMTPA; against the gasoline generation of 38.32 TMTPA in base case with INDMAX unit capacity of 100 TMTPA.

11.1.3 Heat Integration

Apart from the increase in processing capacity, two schemes for enhanced heat integration are planned to be implemented during the revamp. Two reboilers which were using High Pressure (HP) steam and Medium Pressure (MP) steam as heating media are being replaced with new reboilers using internal streams as heating media.

a) One scheme envisages providing a new HCO Circulating Reflux stream for recovery of heat from the Main Fractionator column. This will reduce the consumption of HP steam by 2.5 MT/hr.
b) Second scheme is based on re-routing the existing TCO Circulating Reflux in Main Fractionator column. This will reduce the consumption of MP steam by 1.0 MT/hr.

2. Benefits from the Project:

Net total economic benefit estimated from the project is Rs 9.75 Crore/annum. The benefit was estimated based on the average product prices during 2011-14. In addition to the economic benefit, reduction in fuel consumption because of the enhanced heat integration will directly lead to reduction in emissions from the TPS of the refinery.

11.2 Explanation Of How, Adverse Effects Have Been Mitigated

As per the air quality modeling, no adverse impact of the stack emission to the study area including Amchang Sanctuary is envisaged.
A mere increase in the effluent is expected after revamp which will be treated in existing ETP of Guwahati refinery. The treated effluent will then be reused in the refinery itself.
No significant increase in the noise is envisaged in the study area. Earplugs will be provided to the persons inside the unit during operational phase, however the noise will be expected to

be well within the limit prescribed by OSHAS. Additionally, refinery has a very well developed green belt inside the refinery premises for mitigating adverse impact of noise.
The impact on soil is not envisaged as solid waste generated will be sold to the authorized vendor.

CHAPTER-12:
DISCLOSURE OF CONSULTANTS ENGAGED

CHAPTER-12 : DISCLOSUREOF CONSULTANTS ENGAGED

M/s Mantec consultants Pvt. Ltd, New Delhi was engaged as consultant for carrying out Environmental Impact Assessment Study. Brief Description of the organization is given below:

Name of the Firm	M/s Mantec Consultants Pvt. Ltd, New Delhi
Registered Address	805, Vishal Bhavan 95, Nehru Place, New Delhi-110019
Services Rendered	Environmental Monitoring, Secondary Data Collection, Impact Assessment and Preparation of EIA/EMP reports
QCI Accreditation status	QCI Accredited Consultant at S.No. 97 (as per List of Accredited Consultant Organizations/ Rev. 22A/ September 10, 2014)
EIA Coordinator	Mr. A.S. Brara

Names of the Functional Area Experts engaged with their brief resume and nature of consultancy rendered is provided below.

Functional Area Experts engaged in the project

S.No.	Name of the Consultant	Qualification & Year of Experience	Nature of Consultancy rendered
1.	Mr. A.S. Brara	Mechanical Engg. 49 Years	EIA Coordinator & Consultancy provided in functional area of Noise study.
2.	Mr. S.B. Sinha	M.Sc. (Chemistry), 44 Years	Consultancy provided in functional areas of Water Pollution (WP), Air Pollution (AP), Air Quality (AQ) & Solid & Hazardous Waste Management (SHW)
3.	Dr. Vivek N. Singh	PhD. (Botany), 11 Years	Consultancy provided in functional area Soil Conservation (SC) and Ecology & Biodiversity (EB)
4.	Mr. Anil Kumar	M.A. (Sociology), 9Years	Consultancy provided in functional area of Socioeconomic (SE)
5.	Mr. B.M. Sinha	M.Sc.(Applied Geophysics) 40 Years	Consultancy provided in functional area of Geology
6.	Mr. R. K. Khanna	Civil Engg. 43 Years	Consultancy provided in functional areas of Hydrology, Ground Water & Water Conservation
7.	Mr. Deepak Srivastav	M.Sc (Applied Geologyy) 7 Years	Consultancy provided in functional area of Land Use

S.No.	Name of the Consultant	Qualification & Year of Experience	Nature of Consultancy rendered
8.	Mr. Pintu Kumar	M.Sc., M.Phil (Chemistry) 6 years	Consultancy provided in functional area of Risk Assessment

Associate Functional Area Experts engaged in the project

1	Mr. Gaja Nand Mallick	M.Sc. (Ecology & Environment), 12 years	Assisted Mr V.N.Singh in the functional area of Ecology & Biodiversity (EB).
2	Mr.Manoj Kumar Singh	M.Sc. (Remote Sensing), 3 years	Assisted Mr. Deepak Srivastav in the functional area of Land Use (LU).
3	Mr Muzaffar Ahmed	M.Sc. (Environment Science), 3 years	Assisted Mr. S.B.Sinha in the functional area of Water Pollution (WP) and Air Pollution (AP).
4	Ms Nirjhar Raturi	M.Tech (Energy & Environment Management); 3 years	Assisted Mr. S.B.Sinha in the functional area of Air Quality (AQ) and Air Pollution (AP).
5	Mr Sumit Verma	M.Tech. (Environmental Engg & Management); 3 years	Assisted Mr. S.B.Sinha in the functional area of Water Pollution (WP) and Solid & Hazardous Waste (SHW).

I, hereby, certify that I was a part of the EIA team in the above capacity that developed the EIA Report of ***Revamp of INDMAX unit at Guwahati***.

EIA Coordinator

Name : Mr. **A.S. Brara**

Signature

*List of Functional Areas

1.	LU	:	Land Use
2.	AP	:	Air Pollution Monitoring, Prevention & Control
3.	AQ	:	Meteorology, Air Quality Modeling & Prediction
4.	WP	:	Water Pollution Monitoring, Prevention & Control
5.	EB	:	Ecology & Biodiversity
6.	NV	:	Noise
7.	SE	:	Socio-Economics
8.	HG	:	Hydrology, Ground Water & Water Conservation
9.	GE	:	Geology
10.	SC	:	Soil Conservation
11.	RH	:	Risk Assessment & Hazard Management
12.	SHW	:	Solid & Hazardous Waste Management

Indian Oil

ANNEXURE

of

Final Environment Impact Assessment &

Environmental Management Plan

FOR

Revamp of INDMAX unit at Guwahati Refinery

Submitted To

INDIAN OIL CORPORATION LIMITED

Refineries Division, Guwahati Refinery,
Maniram Dewan Road, Noonmati, Guwahati, Assam-781020

Prepared By

MANTEC CONSULTANTS PVT LTD

805, Vishal Bhawan, 95, Nehru Place, New Delhi-110019,
PH. 011-26429294/5/6, Fax. 011-26463665/26842531, e-mail: mantec@vsnl.com,

Environment Division, D-36, Sector-6, Noida-201 301, U. P.
Ph. 0120-4215000, Fax. 0120-4215809, e-mail: envmantec@yahoo.co.in

March-2015

LIST OF ANNEXURES

ANNEXURE-I:

COPY OF APPROVED TOR

F. No. J-11011/71/2012- IA II (I)
Government of India
Ministry of Environment and Forests
(I.A. Division)

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi – 110 003

E-mail : vp.upadhyay@nic.in
Telefax : 011: 2436 2875
Dated: 10 September, 2013

To,

Shri S P Baruah,
Chief Technical Services Manager,
M/s Indian Oil Corporation Ltd.
Guwahati Refinery, IOCL, Noonmati,
Guwahati, Assam- 781020

E-mail : guptaashok@iocl.co.in, prasadr@indianoil.in; **Fax No.: 011-24360765**

Subject: Revamp of INDMAX Unit at Guwahati Refinery, Guwahati **by M/s Indian Oil Corporation Ltd. – regarding TORs.**
Ref. : Your letter no. HSE/EP/WU-5/EC-APPL/18 dated 9th May, 2013.

Sir,

Kindly refer your letter no. nil dated 9th May, 2013 alongwith project documents including Form-I, Pre-feasibility Report and draft 'Terms of Reference' as per the EIA Notification, 2006. It is noted that proposal is for Revamp of INDMAX Unit at Guwahati Refinery, Guwahati by M/s Indian Oil Corporation Ltd.

2.0 Draft Terms of Reference (TOR) have been discussed and finalized during the 9th Reconstituted Expert Appraisal Committee (Industry) held during 10th-11th June, 2013 for preparation of EIA/EMP report. Following are the 'TORs':

1. Executive summary of the project.
2. Project Description and Project Benefits.
3. Copy of environmental clearance accorded for all the existing projects alongwith point-wise compliance report.
4. Location of National Park/Wild life sanctuary/Reserve Forest within 10 km radius of the project.
5. Details of the total land and break-up of the land use for green belt and other uses.
6. List of products alongwith the production capacities.
7. Manufacturing process details alongwith the chemical reactions and process flow diagram for the proposed project.
8. Is there additional storage required for the proposed products mix, if yes details thereof.
9. Baseline data collection for air, water and soil for last one year.
10. Ambient air quality monitoring for $PM_{2.5}$, PM_{10} SO_2, NOx, (methane & non-methane HC) and VOCs.
11. Existing status of stack emission, raw water requirement, treated effluent quantity & quality data, noise pollution and solid waste management in the existing units.
12. Status of stack emission, raw water requirement, treated effluent quantity & quality data, noise pollution and solid waste management after proposed product mix.
13. Details of Sulphur balance in the existing refinery unit.
14. Additional SO_2 emissions due to the proposed product mix.
15. A note on how SO_2 and NO_X will be controlled at the existing level leading to no increase in pollution load.

16. Unit-wise air pollution control devices to be installed. For the proposed units.
17. Source and permission of water supply.
18. Water balance chart for proposed project. Measures for conservation water by recycling and reuse to minimize the fresh water requirement.
19. Detailed solid waste generation, collection, segregation, its recycling and reuse, treatment and disposal.
20. Details of membership of TSDF for hazardous waste disposal.
21. Details of proposed preventive measures for leakages and accident.
22. Environmental Management Plan
23. Risk Assessment & Disaster Management Plan
    a. Identification of hazards
    b. Consequence Analysis
    c. Risk assessment should also include leakages and location near to refinery & proposed measures for risk reduction.
24. Total capital cost and recurring cost/annum for environmental pollution control measures.
25. Environmental Monitoring programme.
26. Any litigation pending against the project and /or any direction /order passed by any Court of Law against the project, if so, details thereof.

The following general points should be noted:

(i). All documents should be properly indexed, page numbered.
(ii). Period/date of data collection should be clearly indicated.
(iii). Authenticated English translation of all material provided in Regional languages.
(iv). The letter/application for EC should quote the MOEF file No. and also attach a copy of the letter.
(v). A copy of the letter received from the Ministry should be also attached as an annexure to the final EIA-EMP Report.
(vi). The final EIA-EMP report submitted to the Ministry must incorporate the issues in this letter. The index of the final EIA-EMP report must indicate the specific chapter and page no. of the EIA-EMP Report where the above issues have been incorporated.
(vii). 'Certificate of Accreditation' issued by the QCI to the environmental consultant should be included.

3.0 These 'TORs' should be considered for the preparation of EIA / EMP report for Revamp of INDMAX Unit at Guwahati Refinery, Guwahati by M/s Indian Oil Corporation Ltd in addition to all the relevant information as per the 'General Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006. Public hearing was exempted under 7 (ii) of the EIA Notification, 2006

4.0 You are requested to kindly submit the final EIA/EMP prepared as per TORs to the Ministry for considering the proposal for environmental clearance ***within 2 years as per the MoEF O.M. No. J-11013/41/2006-IA.II (I) dated 22nd March, 2010***.

5.0 The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India / National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other Organization(s)/Laboratories including their status of approvals etc.

(V. P. Upadhyay)

Director

Copy to : Chairman, Assam Pollution Control Board, Bahunimatram, Assam, Guwahati.

(V. P. Upadhyay)
Director

ANNEXURE-II:
LAYOUT PLAN

(ISSUED FOR CCE APPROVAL)
APPROVAL UNDER PETROLEUM RULE 2002

LIST OF FACILITIES.

01 CRUDE DISTILATION & GAS OIL NEUTRALIZATION
02 KEROSENE SO2 REFINING UNIT
03 COKE PRODUCING & COKE MECHANIZED TRANS SYSTEM
04 L.P.G. RECOVERY UNIT
05 TEL.BLENDING SHED
06a TANK FARM PUMP HOUSE
07 TANK FARM
08 DRAIN PIT
09 TANK WAGON UNLOADING RACK
09a TRUCK LOADING RACK
010 BOOSTER PUMP HOUSE
010a BLOW DOWN SYSTEM
010b FLARE
011 POWER PLANT BUILDING
012 TRANSFORMER STATION
013 COMPRESSOR STATION
014 TRANSPORT OFFICE
015 TWO WHEELER'S SHED
017 CLARIFLOCULATOR
018 UNIT COOLING TOWER
019 CENTRAL STORE
020 OPERATOR'S CABIN
021b SO2 STORAGE SHED
022 SO2 STORAGE AREA
023a LABORATORY
023b T.P.S COOLING TOWER
024a MECHANICAL WORKSHOP
024b MAINTENANCE BUILDING(CIVIL,ELECTRICAL & INSTRUMENTATION)
025 STORE ROOM
026 FIRE STATION
027 INDUSTRIAL(CONTAINING OIL) & PLANT WATER(SANITATION) RESERVOIR
027a FINAL CLARIFIER I & II
027b COKE FINE SEPERATOR
028 INDUSTRIAL & SANITARY SPENT WATER PUMP HOUSE
029 PUMP HOUSE
030 GARAGE
031 SMOKING BOOTH
032 EFFLUENT SUB STATION
033 REDUNDANT FOAM HOUSE
034 PLANT BOUNDARY WALL
035 ECOLOGICAL PARK
036 ADMN. BUILDING
037 CAFETERIA
038 REFINERY HOSPITAL
039 CHECK & CHANGE ROOM
040 D.C. CONTROL ROOM
041 CRISIS CONTROL ROOM
042a WELFARE OFFICE
042b CISF CHECK GATE
043 UNIT COOLING TOWER SUB-STATION
044 CHLORINE DOSING CHAMBER
045 DM PLANT
046 DDCS CONTROL ROOM
OP5 PUMP HOUSE
V6 WATER TANK FOR COKE CUTTING
07. NEW TANK FARMS - A, B, IV & V (TANKS 85 TO 102)
07. LPG MOUNDED BULLETS AND TANK LORRY FILLING FACILITIES.
07. HYDROGEN STORAGE AND HANDLING FACILITIES.
010B. SOUR FLARE SYSTEM.
013. AIR COMPRESSORS, INST. AIR, SERVICE AIR .
018. NEW UNIT COOLING TOWER.
045. ADDITIONAL DMW CHAIN AND DMW STORAGE.
048. HYDROGEN UNIT.
049. HYDROTREATING UNIT.
050. SOUR WATER STRIPPER UNIT. } SULPHUR BLOCK.
051A. SULPHUR RECOVERY UNIT. } SULPHUR BLOCK.
051B. AMINE TREATING UNIT. } SULPHUR BLOCK.
052. CRYOGENIC NITROGEN UNIT.
053. INDMAX UNIT.
054. ISOSIV UNIT.
055. 3 CUT SPLITTER UNIT.
056. ISOM UNIT.
057. INDAdeptG Unit.

LEGEND:

PROPOSED.
COMPLETED
UNDER REMOVAL

NOTES:

1. ALL DIMENSIONS ARE IN MTR. UNLESS OTHER-WISE STATED.

REV. NO.	DATE	DESCRIPTION	INITIAL
13	12.12.2012	INDAdeptG unit & 150% INDMAX Revamp.	B.S.
12	12.08.2012	COMPLETION OF CDSP	B.S.
11	01.11.2011	COMPLETION OF TANK 107	R.T.
10	02.09.2011	Completion of TK. NO.-13	R.T.
09	26.07.2011	GANTRY MODIFICATION FOR RCO LOADING	R.T.
08	21.08.2010	ROOF CONVERSION OF TK NO.-13	R.T.
07	19.08.2010	INSTALLATION OF NEW COKE CHAMBER.	R.T.
06	19.07.2010	AS BUILT DRAWING FOR PESO COMMISSIONING OF INDMAX 3-CUT SPLITTER(UNIT-55) & FEED TANK -103,104&105.	R.T.
06	18.01.2010	ADDITION OF 2 NOS. LN BULLETS AT GR.	R.T.
05	07.06.2008	EXTENSION OF NEW HT SUB-STATION BLDG., ADDITION OF NEW OFFICE BLDG. NEAR NEW DDCS BLDG, NEW OPERATORS ROOM AT H2 UNIT & EXTENSION OF PLANT B/WALL	R.T.
04	29.07.2007	ADDITION OF MS QUALITY UPGRADATION PROJECT (ISOM UNIT) AT GR.	R.T.
03	08.06.2007	ADDITION OF FLARE GAS RECOVERY SYSTEM AT GR.	R.T.
02	31.05.2007	ADDITION OF NEW ETP AT GR.	R.T.
01	16.10.2006	ADDITION OF 2nd. HYDROGEN BULLET AT GR.	R.T.

INDIAN OIL CORPORATION LTD.
(REFINERY DIVISION)
GUWAHATI REFINERY
ENGINEERING SERVICES

SCALE 1:1500

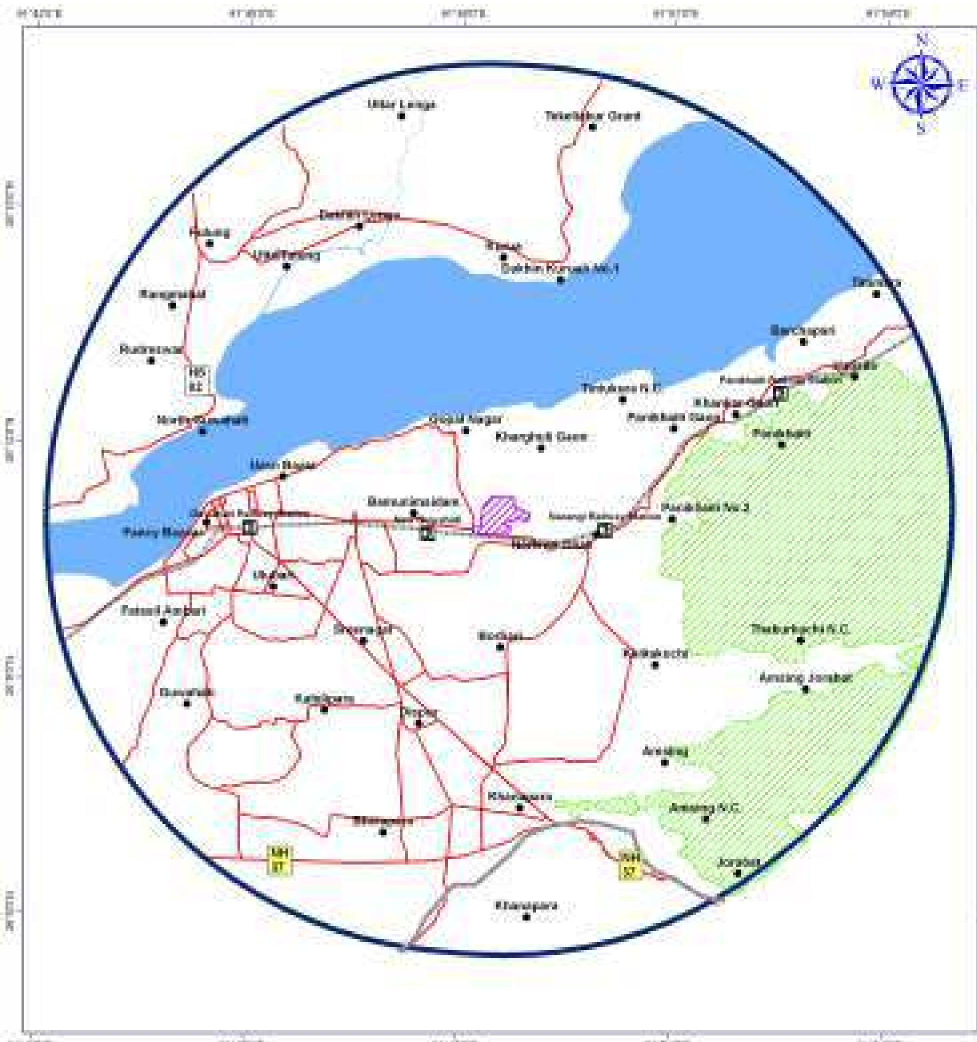
LAYOUT PLAN OF GUWAHATI REFINERY

	DESG.	INITIAL	DATE
DRN.	K. KAGYUNG		12-12-2012
CHD.	SESM		12-12-2012
CHD.	MLE		12-12-2012

CESM
APPROVED

REF DRG. NO.
DRG. NO. :TS-00-150
REV. 13

ANNEXURE-III:
10 KM STUDY MAP



Legend

- Study Area
- Project site
- Habitation
- Amchang WLS
- Railway Line
- Road
- Water Bodies
- Interstate Boundary

ENVIRONMENTAL SENSITIVITY MAP WITH 10 KM STUDY AREA

IOCL GUWAHATI

Guwahati Terminal
District - Kamrup
State - Assam

ANNEXURE-IV:
NOC FROM PCB AND EC FOR PLANT SETUP FOR ISOSIV & INDMAX

POLLUTION CONTROL BOARD, ASSAM
BAMUNIMAIDAM:GUWAHATI-21.

NO.WB/Z-III/T-1986/98-99/21   Dated Guwahati, the 4 ... 1998.

" NO OBJECTION CERTIFICATE "

This " NO OBJECTION CERTIFICATE " is hereby granted to M/S. IOCL Guwahati Refinery for setting up a unleaded MS & Indmax unit with production capacity MS component-312 MT/day ; Neptha-78 MT/day and for Indmax unit-LPG-116 MT/day MS component-67 MT/day ; HSD component-57 MT/day ; LSHD-29 MT/day within its existing premises of Refinery located at Noonmati under the following terms and conditions :-

1. No Air Water Soil Pollution shall be created by the industry beyond the permissible limits prescribed by this Board, the industry would incorporate as adequate pollution control measures before they put the plant into operation.

To maintain the environment any ecology in the area provision for planting selected species of these with in the compound and approaches alongwith provisions for park, garden and fountain shall have to be made . Massive aforestation will have to be made by the Industry in the factory and township, if any.

3. As per provisions of Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981 any Officer empowered, by this Board on its behalf shall without any interruption, the right at any time to enter the industry for inspection, to take samples for analysis and may call for any information etc. Violation of this right will be withdrawal of this permission.

4. As per provisions of the Acts, regular monitoring are to be done by the industry form the locations/points fixed by this Board and the reports to be submitted to the Board monthly.

5. Effluent carrying drains must be segregated from storm water drains and effluent must be disposed in effluent pond. In case, effluent will be allowed to discharge into nearby nullah/natural water course etc. Without treatment and bringing it within permissible limits fixed by the Board.

6. Standard lining and flat embankment of effluent pond shall have to provided in the pond to prevent and control of overflow, seepage and leakage of effluent to the nearby areas .

7. To regularise the subsequent process, the legal provisions of " CONSENT TO OPERATE " as per act and CESS RETURNS as per Cess Act, 1977 shall have to be timely adhered to.

P.T.O.

9. Solid wastes that arise during [illegible] should be properly graded and disposed off Scientifically without causing nuisances .

10. ~~For~~ Fire warning (Alarm,Siren) is to be installed by the industry to guard against accidental pollution/mishap to gether with fire fighting devices.

11. For low lying areas, special care is to be taken by the industry to prevent any overflow, seepage and leakage of effluent.

12. All pipeconnection, joints, fittings to in the factory and plant are to be frequently checked and shall be leak proof all the time.

13. Proper house keeping and adequate maintenance has to be ensured/enforce as per provisions of Acts.

14. All unwanted/toxic chemicals/fluid/gases are to be neutralized and flared up as necessary.

15. Production process is to be monitored and in the event of danger immediate shut down is to be ensured by the industry.

16. The " NO OBJECTION CERTIFICATE " has been issued basing on the perticulars furnished by the applicant and subject to imposition of further/more conditions if warranted by the subsequent development.

17. The " NO OBJECTION CERTIFICATE " will bevalid for one year from the date of issue of this N.O.C.

18. Health working environment for the workers must be maintained and there should not be health hazard to the workers for inadequate arrangements for ventilation dust removal etc. Arrangements should be adequate and full proof for the health of the worker. Their health should be regularly monitored.

19. The industry must submit compliance report of action taken on the conditions given by the Board before commissioning of the plant.

20. Adequate trees should be planted and maintained in the vacant space of the premises and all around the factory and township, if any.

21. The Board will be at liberty to withdraw the "No OBJECTION CERTIFICATE " at any time without notice of necessary steps for prevention of pollution and prevention of environment is not taken by the Industry as per mentioned conditions.

22. The issuance of the " NO OBJECTION CERTIFICATE " (NOC) does not convey any property right in their real or personal property or any exclusive privillages, nor does it authorise any injury to private property nor any invasion right nor any infringement of Central, State or Local Laws or Regulations.

23. The " NO OBJECTION CERTIFICATE " does not authorise or approve the construction

24. The effluent discharge from existing E.T.P. should conform the tolerance limit of the parameters mentioned below :-

Constituents of Pollutants		Tolerance Limit
1. p^H	...	6.00 to 8.5
2. Total Suspended Solids	...	20 mg/1 (max).
3. B.O.D.	...	15 mg/1 (max).
4. Oil & Grease	...	10 mg/1 (max).
5. Phenolic Compounds	...	1.0 mg/1 (max).
6. Sulphides (as S)	...	0.5 mg/1 (max).
7. Temperature	...	shall not exceed 40$C.

8. Other parameters will have to be confirmed as per ISI :2490 (Part-I)

25. Quantitative Standards for Air Pollution :-

Standard for sulphur dioxide emission process

1. The stack is to be 40m in height.
2. SPM concentration should be 150 mg/NM^3

26. Ambient Noise Standard :-

Area	Daytime	Nighttime
1. Industrial	75 db	70 db.
2. Residential	55 db	45 db.

Daytime - 6.00 A.M. to 9.00 P.M.

Nighttime- 9.00 P.M. to 6.00 A.M.

27. Care must be taken by the applicant to avoid any smell from the process.
28. Board has the right to add, delete or modify any of the conditions in future to protect the Environment.
29. The applicant shall submit detailed Environment Management Plan to the Board before commissioning the plant.

4/8/98

(P. C. BARUAH)
MEMBER SECRETARY I/C.

Memo NO.WB/Z-III/T-1986/98-99/21-A Dated Guwahati,the 4th Aug.'98.
Copy to :-

1. M/S. IOCL, Guwahati Refinery, Noonmati, for information and necessary action. The NOC is valid subject to fulfilment of above terms & conditions and also subject to obtaining necessary permission from other Competent Authorities.
2. The Under Secretary to the Govt. of Assam, Science Technology & Environment Department, Dispur, Guwahati-6, for favour of information.
3. The Deputy Commissioner, Kamrup, for favour of information.
4. Director of Industries, Govt of Assam, Bamunimaidam, Guwahati-21, for information & necessary action.
5. Executive Engineer, Regional Office, Guwahati, for information & necessary action.

4/8/98

(P. C. BARUAH)
MEMBER SECRETARY I/C.

(12) Copy: ED(PJ)
DGM(S)-WMS
DGM(E&P)
original to GM-G

No. J-11011/1/2000-IA.II(I)
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FOREST

PARYAVARAN BHAVAN,
CGO COMPLEX, LODI ROAD,
NEW DLEHI - 110 003.

Dated : 24th April, 2000.

To

The Chairman-cum-Managing Director,
Indian Oil Corporation Ltd.
Scope Complex, Core-2,
7, Institutional Area, Lodhi Road,
New Delhi-110003.

DIR(R)

ED(O)

Subject:- Proposed ISOSIV & INDMAX units at Guwahati Refinery by M/s IOCL.

Sir,

This has reference to M/s Indian Oil Corporation Ltd. letter No. EP/EC-APPL dated 30th December, 199 with application and other project documents including EIA, EMP etc. seeking environmental clearance of the Ministry under the provisions of EIA Notification, 1994.

It is noted that the proposal involves installation of ISOSIV Unit for production of unleaded MS (110,00 MTPA)& INDMAX Unit to maximise LPG production (44290 MTPA) at Guwahati Refinery.

The proposal has been examined based on the scrutiny of the project documents and NOC granted by the Assam State Pollution Control Board dated 4th August, 1998 as well as minutes of the public hearing held on 20th September, 1999. The Company has submitted additional clarifications vide their letters dated 22nd February, 2000 and 10th March, 2000. Ministry of Environment and Forests hereby accords environmental clearance to the above refinery proposal subject to strict compliance of the terms and conditions mentioned below:-

Specific Conditions :-

i. The gaseous emission (SO_2 and NOx, HC) from the various process units should conform to the standards prescribed under Environment (Protection) Rules, 1986 or norms stipulated by the SPCB whichever is more stringent. At no time, the emission level should go beyond the stipulated standards. In the event of failure of pollution control system adopted by the unit, the respective unit should not be restarted until the control measures are rectified to achieve the desired efficiency.

ii. Adequate ambient air quality monitoring stations [SO_2, NO_x and HC] should be set up in the refinery area in consultation with SPCB, based on occurrence of maximum ground level concentration and down-wind direction of wind. The monitoring network must be decided based on modeling exercise to represent short term GLCs.

Continuous on-line stack monitoring equipment should be installed for measuremen of SO_2, NO_x and HC.

iii. Data on ambient air-quality and stack emissions as well as fugitive emissions of HC from process storage tank yard, crude oil tanks etc. must be regularly monitored and submitted to CPCB/SPCB once in 3-months and to Ministry [Regional Office, Shillong] once in 6-months.

iv. Liquid effluent generated from the refinery should be treated comprehensively to conform to the load based standards and concentration limits prescribed under EPA rules [MINAS Standards]. In consultation with SPCB, adequate number of influent and effluent quality monitoring stations has to be planned. Regular monitoring of the effluent [industrial/domestic and others] quality should be carried out and monitored data submitted quarterly to CPCB/SPCB and half yearly to Ministry [Regional Office, Shillong]. The Company must undertake maximum recycling/reusing of the treated effluent for process purposes in addition to green belt development and also adopt adequate water conservation measures. The effluent quality must also be monitored periodically by an independent agency authorized by CPCB and report of the independent agency submitted to Ministry/CPCB/Assam.

v. Guard ponds of sufficient holding capacity should be provided to contain the effluent during process disturbances and or ETP failure. The concerned units must be shut down in cases of effluent quality exceeding the prescribed limits.

vi. The Company must adopt mounded storage for LPG. The recommendations made in the Risk Assessment Report must be incorporated while firming up the plant layout and equipment design. The Company must prepare a comprehensive risk assessment/Analysis of the Refinery and associated facilities once the engineering design and lay out is frozen. Based on this, on-site and off-site emergency preparedness plan must be prepared. Approval from the nodal agency must be obtained before commissioning the project.

vii. The Company should explore the feasibility of increasing the density of green belt within the refinery.

General Condition :

i. The project authority must adhere to the stipulations made by Assam State Pollution Control Board and State Government.

ii. No expansion or modification of the plant should be carried out without prior approval of this Ministry.

iii. Handling, manufacturing, storage and transportation of hazardous chemicals should be carried out in accordance with the Manufacture, Storage & Import of Hazardous chemicals Rules, 1989, as amended in 1991. Permissions from State and Central nodal agencies in this regard must be obtained.

iv. Hazardous wastes, if any, must be handled and disposed as per Hazardous waste (Management and Handling) Rules, 1989. Authorization from State Pollution Control Board in this regard must be obtained.

v. Adequate provisions for infrastructure facilities such as water supply, fuel, sanitation etc. should be ensured for construction workers during the construction phase so as to avoid felling of trees and pollution of water and the surroundings.

vi. The overall no levels in and around the plant area should be kept well within the standards [85dBA] by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA [day time] and 70 dBA [night time].

vii. Occupational Health Surveillance of the workers should be done on a regular basis and records maintained.

viii. The project oponent shall also comply with all the environmental protection measures and safeguards recommended in the EIA/EMP.

ix. A separate environmental management cell with full fledged laboratory facilities to carry out various management and monitoring functions should be set up under the control of Senior Executive.

x. The funds earmarked for the environmental protection measures should not be diverted for any other purpose and year-wise expenditure should be reported to this Ministry and SPCB.

xi. Six monthly status report on the project vis-a-vis implementation of environmental measures should be submitted to this Ministry (Regional Office, Shillong /CPCB/SPCB.

xii. The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/ Committee and may also be seen at Website of the Ministry and Forests at http:/WWW.envfor.nic.in. This should be advertised in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned.

xiii. The Project Authorities should inform the Regional Office as well as the Ministry the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.

4.0 The Ministry or any competent authority may stipulate any further condition(s) on receiving reports from the project authorities. The Regional Office of this Ministry located at Shillong will monitor the above conditions.

5.0 The Ministry may revoke or suspend the clearance if implementation of any of the above conditions is not satisfactory.

6.0 Any other conditions or alternation in the above conditions will have to be implemented by the project authorities in a time-bound manner.

7.0 The above conditions will be enforced, inter-alia under the provisions of the Water (Prevention and Control of Pollution) Act, 1974 the Air (Prevention and Control of Pollution) Act, 1981 the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and rules.

Yours faithfully,

(Dr.R.Warrier)
Joint Director

Copy to :-

1. Secretary, Mini. 'ry of Petroleum and Natural Gas, Government of India, Shastri Bhavan, New Delhi - 110 001.
2. Secretary, Department of Science, Technology & Environment, Assam Secretariat, Govt.of Assam, Guwahati- 781006.
3. Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
4. The Chairman, Assam Pollution Control Board,A ssam ,Bamunimaidan,Guwahati-781021.
5. The Chief Conservator of Forests, Regional Office (NEZ) Upland Road, Laitumkhrah, Shillong-793003.
6. Senior Adviser (EI), Ministry of Environment & Forests, New Delhi.
7. Addl. Director (Monitoring Cell), Ministry of Environment & Forests, New Delhi.
8. Guard file.
9. Record file.

(Dr.R.Warrier)
Joint Director

ANNEXURE-V:

EC LETTER FOR MS QUALITY IMPROVEMENT

भारत सरकार
पर्यावरण एवं वन मंत्रालय
Government of India
Ministry of Environment & Forests
(IA Division)

Indian Oil Corpn. Limited
Guwahati Refinery
Despatch & Receipt Section
- 6 MAR 2008
RECEIVED
HUMAN RESOURCE DEPTT.

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi – 110 003
E-mail: hsmalviya@gmail.com
Telephone: 011: 2436 7076

F. No. J-11011/215/2007-IA-II(I) Dated : February 7, 2008

CTSM (SNM)

6/3/08

To,

M/s Indian Oil Corporation Ltd.
(Guwahati Refinery)
P.O. Noonmati
Guwahati - 781020
Assam

mishraac@iocl.co.in

Sub : MS Quality Improvement project at Guwahati Refinery in Guwahati District in Assam by M/s Indian Oil Corporation Ltd. – Environmental Clearance reg.

Sir,

This has reference to your letter EP/EC-APPL dated 17th October, 2007 along with EIA/EMP, risk assessment report, copy of final lay out plant and copy of pre-feasibility report seeking environmental clearance under EIA notification 2006.

2. The Ministry of Environment and Forests has examined the documents and noted that the proposal is for environmental clearance for MS quality improvement to meet the Euro III norms as per auto fuel policy. The project will be executed in the existing premises. Production capacity for the naphtha splitter, 3-cut splitter unit and isomarisation unit with naphtha hydro-treater would be 67 TMTPA, 55TMTPA and 45 TMTPA respectively. Floating roof type of storage tanks for naphtha (3X2000KL) and MS (Euro-III) (2X5000 KL) will be installed. Public hearing of the project is not required as per para 7(ii) of the EIA Notification 2006. Cost of the project is Rs.200 Crores.

3. The Ministry of Environment and Forests hereby accords environmental clearance to the above project under the provisions of EIA Notification, 2006 subject to strict compliance of the following Specific and General Conditions:

A. SPECIFIC CONDITIONS:

i. The company shall comply with new standards/norms that are being proposed by the CPCB for petrochemical plants and refineries.

ii. The company shall comply with all the stipulations of environmental clearance issued vide File No. – 11011/375/2006-IA.II(I) dated 22nd March, 2007.

iii. The process emissions (SO_2, NO_x, HC, VOCs and Benzene) from various units shall conform to the standards prescribed by the Assam State Pollution Control Board from time to time. At no time, the emission levels shall go beyond the stipulated standards. In the event of failure of pollution control system(s) adopted by the unit, the unit shall be immediately put out of operation and shall not be restarted until the desired efficiency has been achieved.

iv. The improvement project shall be installed within the existing premises and no additional land shall be acquired for the project.

v. Quarterly monitoring of fugitive emissions shall be carried out as per the guidelines of CPCB by fugitive emission detectors (GMI Leak Surveyor) and reports shall be submitted to the Ministry's regional office at Shillong.

vi. For control of fugitive emission all unsaturated hydro carbon will be routed to the flare system and the flare system shall be designed for smoke less burning.

vii. The company shall strictly follow all the recommendation mentioned in the charter on corporate responsibility for environmental protection (CREP).

viii. Occupational health surveillance of worker shall be done on a regular basis and records maintained as per the Factory Act.

ix. Greenbelt shall be developed to mitigate the effect of fugitive emission all around the plant in a minimum 30% plant area in consultation with DFO as per CPCB guidelines.

x. The Company shall make the suitable arrangement for disposal of catalyst waste and alumina balls. The report of disposal of this wastes shall be submitted to Ministry's Regional Office at Shillong.

xi. The Company shall take necessary measures to prevent fire hazards, containing oil spill and soil remediation as needed. At place of ground flaring, the overhead flaring stack with knockout drums shall be installed to minimize gaseous emissions during flaring.

xii. To prevent fire and explosion at Oil and Gas facility, potential ignition sources should be kept to a minimum and adequate separation distance between potential ignition sources and flammable material shall be in place.

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 and any other statuary body.

ii. No further expansion or modification in the project shall be carried without prior approval of the Ministry of Environment and Forests. In case of deviations or alternations in the project proposal from those submitted to the Ministry for clearance, a fresh reference shall be made to the Ministry.

iii. At no time, the emissions should go beyond the prescribed standards. In the event of failure of any pollution control system, the respective well site should be immediately put out of operation and should not be restarted until the desired efficiency has been achieved. Provision of adequate height of stack attached to DG sets & flare is to be done.

iv. Wastewater shall be properly collected and treated so as to conform to the standards prescribed under EP Act & Rules and mentioned in the Consents provided by the relevant SPCB.

v. The overall noise levels in and around the premises shall be limited within the prescribed standards (75 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA (day time) and 70 dBA (night time).

vi. The project authorities must 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 etc. Necessary approvals from Chief Controller of Explosives must be obtained before commission of the expansion project, if required. Requisite On-site and Off-site Disaster Management Plans will be prepared and implemented.

vii. Handling of Hazardous Waste shall be as per the Hazardous Waste (Management & Handling) Rules 2003. Authorization from the State Pollution Control Board must be obtained for collections/treatment/storage/disposal of hazardous wastes.

viii. The project authorities will provide adequate funds as non-recurring and recurring expenditure to implement the conditions stipulated by the Ministry of Environment and Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purposes.

ix. The company shall develop rain water harvesting structures to harvest the run off water for recharge of ground water.

x. 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 should be submitted to them regularly. It will also be displayed on the Website of the Company.

xi. The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/ Committee and may also be seen at Website of the Ministry of Environment and Forests at http://www.envfor.nic.in. This should be advertised within seven days from the date of issue of the clearance letter at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the concerned Regional office of this Ministry.

xii. A separate environment management cell with full fledged laboratory facilities to carry out various management and monitoring functions shall be set up under the control of a Senior Executive.

xiii. The project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of the project

4. The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

5. The Ministry reserves the right to stipulate additional conditions if found necessary. The company will implement these conditions in a time bound manner.

6. 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, 2003 and Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989/2000 along with their amendments and rules.

(H.S. Malviya)
Joint Director

Copy to :

1. The Secretary, Department of Environment, Science & Technology, Assam Secretariat, Government of Assam, Guwahati- 781 006.

2. Chief Conservator of Forests, Ministry of Environment & Forests, Regional Office (NEZ),Upland Road, Laitumkhrah, Shillong : 793 003,Meghalaya.

3. The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi 110 032.

4. The Chairman, Assam State Pollution Control Board, Bamunimaidan, Guwahati- 781 021, Assam.

5. Monitoring Cell, Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, New Delhi.

6. Guard File.

7. Monitoring File.

8. Record File.

(H.S. Malviya)
Joint Director

ANNEXURE-VI:
POINT WISE COMPLIANCE REPORT ON ENVIRONMENTAL STIPULATIONS

इंडियन ऑयल कॉर्पोरेशन लिमिटेड
रिफाइनरी प्रभाग : गुवाहाटी रिफाइनरी
नूनमाटी, गुवाहाटी-७८१०२०, असम
Indian Oil Corporation Limited
Refineries Division : Guwahati Refinery
Noonmati, Guwahati - 781020, Assam.
Fax : 0361-2657250, 2657251
Tele (Board) : 0361-2597777
Gram : OILREFIN
Internet Site : www.iocl.com

रिफाइनरीज प्रभाग
Refineries Division

Ref.No.:GR//HSE/303/2014/1

Date: 12-July-14

To,
Joint Director(S)
Ministry of Environment & Forest,
Govt. of India,
North Eastern Regional Office,
Lumbatngen (LAW-U-SIB),
Shillong-793 021

Sub: Submission of half-yearly compliance report on Environment Stipulations.

a) Ref. No: MOEF LETTER NO> J-11011/1/2000-1A 11(1) dt. 24/04/2000 for ISOSIV & INDMAX.
b) Ref. No: MOEF LETTER NO> J-11011/215/2007-1A 11(1) dt. 07/02/2008 for ISOM unit.

Dear Sir,

Please find enclosed herewith the compliance report of environmental stipulations for (Oct'13-Mar'14)
With warm Regards,

Your Sincerely
For and on behalf of IOCL,
Guwahati Refinery,

12/7/14

(Monika Das)
Chief Manager
Health, Safety and Environment.

Copy to :

Director
Ministry of Environment & Forests
Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi-110 003

STATUS OF ENVIRONMENTAL CLEARANCE CONDITIONS AS ON 31.03.2014

Ref: MOEF LETTER NO. J-11011/1/2000-1A II(I) dt.24/04/2000

Sl. No	Conditions	Status as on 31.3.2014
	SPECIFIC CONDITIONS	
1.	The gaseous emission (SO_2 and NOx, HC) from the various process units should conform to the standards prescribed under Environment (Protection) Rules, 1986 or norms stipulated by the SPCB whichever is more stringent. At no time, the emission level should go beyond the stipulated standards. In the event of failure of pollution control system(s) adopted by the unit, the respective unit should not be restarted until the control measures are rectified to achieve the desired efficiency.	**Complied.** Emissions from the process Units are monitored every month and the results are well within the applicable norms. Monitoring results **Annex- I.** **Complied.**
2.	Adequate ambient air quality monitoring stations (SO_2 and NOx, HC) should be set up in the refinery area in consultation with SPCB, based on occurrence of maximum ground level concentration and down-wind direction of wind. The monitoring network must be decided based on modeling exercise to represent short term GLCs. Continuous on-line stack monitoring equipment should be installed for measurement of SO_2 and NOx , HC.	**Complied.** Already 4 nos. of Ambient Air Monitoring stations based on down wind GLC contour and discussions with APCB are in regular operation. One CAAQM station is commissioned in Dec.2008. Stack Monitoring is done once a month with Stack Monitoring kit. Avg. data for last six months is enclosed as **Annexure-I.** On line analysers for SO_X & NOx are operating in CDU, Indmax, DCU, TPS Blrs, HGU, HDT.HC is being monitored through outside agency.
3.	Data on ambient air quality and stack emissions as well as fugitive emissions of HC from product	**Complied.** Ambient Air and stack emissions are

Sl. No	Conditions	Status as on 31.3.2014
	storage tank yard, crude oil tanks etc. must be regularly monitored and submitted to CPCB/ SPCB once in 3 months and to Ministry (Regional Office Shillong) once in 6 months.	regularly monitored and data submitted to SPCB/CPCB/MoEF as per schedule. Data on last six months enclosed as **Annexure-II**. Fugitive emission data collected is enclosed as **Annexure -III**
4.	Liquid effluent generated from the refinery should be treated comprehensively to conform to the load based standards and concentration limits prescribed under EPA rules (MINAS Standards). In consultation with SPCB, adequate number of influent and effluent quality monitoring stations has to be planned. Regular monitoring of the effluent (industrial/domestic and others) quality should be carried out and monitored data submitted quarterly to CPCB/SPCB and half yearly to Ministry (Regional Office, Shillong). The Company must undertake maximum recycling/reusing of the treated effluent for process purposes in addition to green belt development and also adopt adequate water conservation measures. The effluent quality must also be monitored periodically by an independent agency authorized by CPCB and report of the independent agency submitted to Ministry/ CPCB/Assam.	**Complied.** Liquid effluent is treated in ETP through physical, chemical and Biological process to conform to standards. **Complied.** Well identified sampling points are available and being used by refinery as well as APCB. The locations are within refinery as well as at the out-fall near Saraighat in river Brahmaputra **Complied.** Monitored data are being submitted to SPCB/CPCB quarterly and MoEF six monthly. Monitored Data enclosed as **Annexure-IV.** At present around 90% of treated effluent water is reused as coke cutting water, Fire fighting, Cooling water make up and Horticulture. **Complied.** The effluent quality monitored by testing through M/S Mitra SK pvt. Ltd. Kolkata.
5.	Guard ponds of sufficient holding capacity should be provided to contain the effluent during process disturbances and or ETP failure. The concerned units must be shutdown in cases of effluent quality exceeding the prescribed limits.	**Complied.** Besides 2 nos. of guard ponds having capacity of more than 6000 M^3, emergency reservoir is also available to contain effluent during process disturbances.
6.	The Company must adopt mounded storage for LPG.	2 nos. of mounded LPG storage of 750 MT capacity commissioned in Dec.'03. **Complied.**

Sl. No	Conditions	Status as on 31.3.2014
	The recommendations made in the Risk Assessment Report must be incorporated while firming up the plant layout and equipment design. The Company must prepare a comprehensive risk assessment/ Analysis of the Refinery and associated facilities once the engineering design and lay out is frozen. Based on this, on-site and off-site emergency preparedness plan must be prepared. Approval from the nodal agency must be obtained before commissioning the project.	All recommendations of RA report have implemented. Major recommendations were decommissioning of KTU, installation of mounded bullets for LPG. **Complied.** Risk Assessment was conducted through M/S KLG-TNO in March '02. It has again carried out by M/S DNV in Oct.'10. On-site and Offsite Emergency Preparedness Plan prepared accordingly and updated periodically. **Complied.** CCE approval was obtained. **Complied.**
7.	The Company should explore the feasibility of increasing the density of green belt within the refinery.	**Complied.** Because of space constraint & safety reason green belt cannot be expanded in the refinery. However the plantation is taken up in township areas. About 2475 tree saplings planted in 2013-14.
	GENERAL CONDITIONS	
1.	The project authority must adhere to the stipulations made by the Assam State Pollution Control Board and State Government.	**Complied**. Stipulation of SPCB are complied.
2.	No expansion or modification of the plant should be carried out without prior approval of this Ministry.	**Being Complied.** Expansion of ISOSIV, Indmax unit shall not be done without approval of Ministry.
3.	Handling, manufacturing, storage and transportation of hazardous chemicals should be carried out in accordance with the Manufacture, Storage and Import of Hazardous chemicals Rules, 1989, as amended in 1991. Permissions from State and Central nodal agencies in this regard must be obtained.	**Complied.**
4.	Hazardous wastes, if any, must be handled and	**Complied.**

Sl. No	Conditions	Status as on 31.3.2014
	disposed as per Hazardous waste (Management and Handling) Rules, 1989. Authorization from State Pollution Control Board in this regard must be obtained.	Present authorization is valid upto 27th August '14.
5.	Adequate provisions for infrastructure facilities such as water supply, fuel, sanitation etc. should be ensured for construction workers during the construction phase so as to avoid felling of trees and pollution of water and the surroundings.	**Complied.** Facilities viz. Water, shelter sanitation etc. were provided to construction workers while implementing the project.
6.	The overall noise levels in and around the plant area should be kept well within the standards (85 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA (daytime) and 70 dBA (nighttime).	**Complied.** Regular monitoring is done results are well within the prescribed limits. Observations are attached as **Annx-V.** **Complied.** Regular monitoring is done. Results are well within the prescribed limits.
7.	Occupational Health Surveillance of the workers should be done on a regular basis and records maintained.	**Complied.** Surveillance of the workers is done as per schedule. Health Check up for operators working in hazardous area is done yearly and for other employees of more than 40 years age and above is done once in a year as per normal practices and record maintained.
8.	The project proponent shall also comply with all the environmental protection measures and safeguards recommended in the EIA/EMP.	**Complied.** Recommendations of EIA & EMP are complied.
9.	A separate environmental management cell with full fledged laboratory facilities to carryout various management and monitoring functions should be set up under the control of Senior Executive.	**Complied.** Separate environment management cell headed by DGM exists. Laboratory facility is available in the refinery.
10.	The funds earmarked for the environmental protection measures should not be diverted for any other purpose.	**Complied.** Following funds is being utilized during the year 2013-14

Sl. No	Conditions	Status as on 31.3.2014
	Year-wise expenditure should be reported to this Ministry and SPCB.	Environment monitoring – Rs 29.79 Lakhs (approx.). Bioremediation :Rs 37.5lakhs Water Pinch Study -Rs 5.14 Lakhs Rain water harvesting -Rs 4.5lakhs Tree Plantation:Rs 0.25lakhs No funds diverted.
11.	Six monthly status report on the project vis-à-vis implementation of environmental measures should be submitted to this Ministry (Regional Office, Shillong/CPCB/SPCB.	**Complied.** Reports are being sent as per recommended schedule and also uploaded on the website " www.iocl.com"
12.	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/ Committee and may also be seen at Website of the Ministry and Forests at http:/WWW.envfor.nic.in. This should be advertised in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned.	**Complied.** Publication in Local Dailies Assamese and English has been done on 10.6.2000.
13.	The Project Authorities should inform the Regional Office as well as the Ministry the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	**Complied.** Approval by IOCL Board ISOSIV : 02.01.98, INDMAX : 19.8.98 The date of start of land development work is not applicable as the Project works started within the existing refinery land

Annexure -I

Data on Stack Emission Monitoring at Guwahati Refinery (Oct'13-Mar'14)

Stack	Concentration (mg/NM3)		
	PM	SO2	NOX
CDU	73-96	440-520	134-229
DCU	35-88	256-503	99-195
TPS Boilers			
Blr 5	49-70	421-595	133-216
Blr 6 & 7	36-70	476-709	176-309
HDT	21-57	42-131	68-197
HGU	24-47	103-321	73-122
INDMAX	63-85	94-236	90-141
ISOM	21-45	32-196	116-159

Annexure-II

Data on Ambient Air Monitoring at Guwahati Refinery (Oct'13-Mar'14)

Values in ug/m3

AMBIENT AIR QUALITY MONITORING REPORT												
Sampling and analysis done by M/S Mitrask pvt. Ltd.,Kolkata												
	Concentration of Pollutants											
	SO2	NO2	PM 10	PM 2.5	Ozone (O3)	Lead (Pb)	CO	Ammonia (NH3)	Benzene (C6H6)	Benzo(O) Pyrene	Arsenic (As)	Nickel (Ni)
	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	mg/m3	μg/m3	μg/m3	ng/m3	ng/m3	ng/m3
Limit as per CPCB notification, New Delhi,18th Nov, 2009.for Ambient air quality	80	80	100	60	100	1	2	400	5	1	6	20
Location : Admn Building												
Max.	12.4	56.8	97.0	58.0	BDL	0.10	1.0	68.5	5.0	BDL	BDL	18.7
Min.	4.6	22.6	55.0	29.0	BDL	0.01	0.5	22.0	3.6	BDL	BDL	4.8
Avg.	7.7	36.1	80.6	43.3	BDL	0.01	0.8	33.4	3.9	BDL	BDL	10.4

Location : Guest House											
Max.	10.2	54.9	96.0	58.0	BDL	0.05	0.9	57.2	3.5	BDL	BDL	15.9
Min.	4.2	21.6	45.0	24.0	BDL	0.01	0.4	20.2	3.3	BDL	BDL	5.3
Avg.	6.2	32.7	72.6	39.1	BDL	0.02	0.6	31.8	3.3	BDL	BDL	9.8
Location : Sector II											
Max.	12.7	56.7	99.0	58.0	BDL	0.08	1.0	48.3	4.8	BDL	BDL	18.7
Min.	4.5	23.6	52.0	27.0	BDL	0.03	0.3	17.5	3.3	BDL	BDL	5.5
Avg.	7.6	36.8	80.9	44.4	BDL	0.03	0.7	30.8	3.6	BDL	BDL	10.8
Location : WTP											
Max.	8.5	40.5	88.0	50.0	BDL	0.04	0.8	48.3	0.0	BDL	BDL	12.2
Min.	4.0	17.5	42.0	23.0	BDL	0.00	0.2	20.0	0.0	BDL	BDL	3.3
Avg.	5.4	28.2	65.6	34.8	BDL	0.02	0.4	28.9	0.0	BDL	BDL	7.7
	Detection Limit of O3 : 19.62 µg/m3,Pb : 0.02 µg/m3, Ni: 1.0 ng/m^3 As : 2 ng/ m3 , C_6H_6: 2.8 µg/m3 , Benzo(a)pyrene : 0.2 ng/m3 .										

Annexure III

RESULTS OF FUGITIVE EMISSION MONITORING

AT GUWAHATI REFINERY FOR ((Oct'13-Mar'14)

Fugitive Emission

		H2U & HDT	Boiler 6&7	CDU	SRU	DCU
Oct-13	Total HC(ppm)/Benzene(mg/m3)	0.85/0.0585	0.096/0.0305	2.05/0.102	2.32/0.0895	1.23/0.085
Nov-13	Total HC(ppm)/Benzene(mg/m3)	1.15/0.066	1.06/0.044	3.09/0/.112	3.67/0.097	3.1/0.092
Dec-13	Total HC(ppm)/Benzene(mg/m3)	2.2/0.054	0.75/0.02431	3.18/0.177	2.79/0.094	3.93/0.105

		H2U & HDT	Boiler 3&4	CDU	SRU	DCU
Jan-14	Total HC(ppm)/Benzene(mg/m3)	3.77/0.129	5/0.1	4.1/0.088	2.82/0.0667	1.23/0.085
Feb-14	Total HC(ppm)/Benzene(mg/m3)	4.62/0.146	3.91/0.088	5.97/.103	3.86/0.097	6.85/0.154
Mar-14	Total HC(ppm)/Benzene(mg/m3)	6.37/0.198	5.34/0.171	8.31/0.132	7.68/0.201	9.63/0.237

Annexure-IV

Data on Discharged Effluent Analysis at Guwahati Refinery (Oct'13-Mar'14)

Sl. No.	Parameter	Concentration value (mg/l except pH)	Concentration value (mg/l except pH)	%age Compliance
		National Limit	Average	
1	pH	6.0 – 8.5	7.05	100
2	Oil & Grease	5	2.38	100
3	BOD	15	6.62	100
4	COD	125	17.40	100
5	TSS	20	13.66	100
6	Phenols	0.35	0.07	100
7	Sulphides	0.5	0.01	100
8	CN	0.2	0.01	100
9	Ammonia as N	15	2.71	100
10	TKN	40	6.79	100
11	P	3	0.26	100
12	Cr (Hexavalent)	0.1	0.05	100
13	Cr (Total)	2	0.01	100
14	Pb	0.1	0.01	100
15	Hg	0.01	0.00	100
16	Zn	5	0.05	100
17	Ni	1	0.01	100
18	Cu	1	0.02	100
19	V	0.2	0.20	100
20	Benzene	0.1	0.01	100
21	Benzo (a) - Pyrene	0.2	0.01	100

Load Mass Based Effluent data
(Oct'13-Mar'14)

Figs in Kg/1000 tonnes crude

Sl. No.	Parameter	Quantum value (kg/TMT of Crude processed)	Quantum value (kg/TMT of Crude processed)
		National Limit	Average
1	pH	--	--
2	Oil & Grease	2	0.409
3	BOD	6	1.134
4	COD	50	2.895
5	TSS	8	2.358
6	Phenols	0.14	0.013
7	Sulphides	0.2	0.002
8	CN	0.08	0.002
9	Ammonia as N	6	0.508
10	TKN	16	1.241
11	P	1.2	0.040
12	Cr (Hexavalent)	0.04	0.008
13	Cr (Total)	0.8	0.002
14	Pb	0.04	0.002
15	Hg	0.004	0.000
16	Zn	2	0.005
17	Ni	0.4	0.002
18	Cu	0.4	0.003
19	V	0.8	0.014
20	Benzene	0.04	0.001
21	Benzo (a) -Pyrene	0.08	0.001
	Effluent discharge,M3/TMT of crude processed	400/700	166

Annexure - V

NOISE LEVEL MONITORING
BATTERY AREA
GUWAHATI REFINERY(Oct'13-Mar'14)

NOISE LEVEL MONITORING REPORT FOR THE MONTH OF OCT-MAR 2014

NO. MED/OHC/2014/

SL. NO.	AREA	LOCATION	AVERAGE EXPOSURE FOR AN EMPLOYEE PER SHIFT (HRS)	READING IN dBA
1	TPS	Boiler - 3	1.30 hrs	93.0
		Boiler - 4	1.30 hrs	OFF
		Boiler - 5	1.30 hrs	95.0
		Boiler - 6	1.30 hrs	95.0
		Boiler - 7	1.30 hrs	93.0
		Boiler Control Room	8.0 hrs	65.0
		TG - 3	1.30 hrs	OFF
		TG - 4	1.30 hrs	98.5
		TG - 5	1.30 hrs	96.0
		Turbine Control Room	8.0 hrs	65.5
		DM Plant Pump Area	1.30 hrs	95.5
		DM Plant Control Room	8.0 hrs	64.5
2	CDU	Model Pump House	1.30 hrs	94.5
		Cold Pump House	1.30 hrs	94.0
		Hot Pump House	1.30 hrs	93.5
		NSF Area	1.30 hrs	94.0
		CDU Field Control Room	8.0 hrs	66.0
3	DCU	Cold Pump House	1.30 hrs	94.0
		Hot Pump House	1.30 hrs	94.5
		Air Compressor Area	1.30 hrs	93.0
		DCU Field Control Room	8.0 hrs	67.5
4	NITROGEN	Air Compressor 013-K-01A	1.00 hr	99.0
		Air Compressor 013-K-01B	1.00 hr	OFF
		Air Compressor 013-K-	1.00 hr	OFF

		01C		
		Nitrogen Field Control Room	8.0 hrs	63.5
5	INDMAX	Main Air Blower Area	1.00 hr	96.0
		INDMAX Field Control Room	8.0 hrs	64.5
6	SRU	Main Air Blower 51A-K-01A	1.30 hrs	OFF
		Main Air Blower 51A-K-01B	1.30 hrs	97.5
		SRU Field Control Room	8.0 hrs	63.5
7	HDT	Pump Area	1.00 hr	95.0
		HDT/HGU Field Control Room	8.0 hrs	67.0
8	HGU	Pump Area	1.00 hr	95.0
		HDT/HGU Field Control Room	8.0 hrs	67.0
9	MSQU	Pump Area	1.00 hr	95.0
		MSQU Field Control Room	8.0 hrs	66.5
10	ETP	Air Blower Area	1.00 hr	97.0
		ETP Control Room	8.0 hrs	67.5

Permissible Noise Level For Continuous Exposure (OISD-GDN-166, JULY 1997.)

DURATION PER DAY (HOURS)	SOUND LEVEL (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
1/2	110
1/4 or less	115

Indian Oil

STATUS OF ENVIRONMENTAL CLEARANCE CONDITIONS AS ON 31.03.2014

Ref: MOEF LETTER NO. 1-11011/215/2007-1A-H(I) Dt. 7th Feb.2008.

S. No	Conditions	Status as on 31.3.2014
	SPECIFIC CONDITIONS	
1.	The Company shall comply with new standards/norms that are being proposed by the CPCB for petrochemical plants and refineries.	New norms/standards are being complied.
2.	The company shall comply with all the stipulations of environmental clearance issued vide File No.11011/375/2006-IA.H(I) dated 22nd March 2007	Guwahati Refinery obtained no such environmental clearance.
3.	The process emission (SO2, Nox, HC, VOCs and Benzene) from various units shall confirm to the standards prescribed by the Assam State Pollution Control Board from time to time. At no time, the emission levels shall go beyond the stipulated standards. In the event of failure of pollution control system(s) adopted by the unit, the unit shall be immediately put out of operation and shall not be restarted until the desired efficiency has been achieved.	**Complied.** Emissions from the process Units are monitored every month and the results are well within the applicable norms. Data for the last months enclosed as **Annexure-I&II.** Fugitive emission data collected is enclosed as **Annexure -III** **Complied.**
4.	The improvement project shall be installed within the existing premises and no additional land shall be acquired for the project.	**Complied.** The proposed project shall be installed within the existing premises.
5.	Quarterly monitoring of fugitive emissions shall be carried out as per the guidelines of CPCB by fugitive emission detectors (GMI Leak Surveyor) and reports shall be submitted to the Ministry's regional office at Shillong.	**Complied.** (Attached as **Annx-III**)
6.	For control of fugitive emission all unsaturated hydrocarbon will be routed to the flare system and the flare system shall be designed for smokeless burning.	**Complied.** All uncontrolled hydrocarbon from flare are routed through FGRS unit for its recovery. Only minimum quantity of

S. No	Conditions	Status as on 31.3.2014
		hydrocarbon is allowed to burn in smokeless flare.
7.	The Company shall strictly follow all the recommendation mention in the charter on corporate responsibility for environmental protection (CREP).	**Complied.** Is being followed strictly.
8.	Occupational health surveillance of worker shall be done on a regular basis and records maintained as per the Factory Act.	**Complied.** Regular health checks up done to employees as per the factory and report send to APCB regularly.
9.	Greenbelt shall be developed to mitigate the effect of fugitive emission all around the plant in a minimum 30% plant area in consultation with DFO as per CPCB guidelines.	**Complied.** Because of space constraint & safety reason green belt cannot be expanded in the refinery. However the plantation is taken up in township areas. About 2475 tree saplings planted in 2013-14.
10.	The company shall make suitable arrangement for disposed of catalyst waste and alumina balls. The report of disposal of this waste shall be submitted to Ministry's regional office at Shillong.	Provisions of MSIHC Rules, 1989 and amendments are followed. MoE&F shall be kept informed whenever catalyst waste is disposed.
11.	The company shall take necessary measures to prevent fire hazards, containing oil spill and soil remediation as needed. At place of ground flaring, the overhead flaring stack with knockout drums shall be installed to minimize gaseous emissions during flaring.	Refinery has install fire fighting facilities in compliance with OISD standards. However, there is no ground flaring system followed in the Refinery.
12.	To prevent fire and explosion at oil and gas facility, potential ignition sources should be kept to a minimum and adequate separation distance between potential ignition sources and flammable material shall be in place.	**Complied.** All applicable Petroleum rules & OISD standards are followed for laying out various facilities.
	GENERAL CONDITIONS	
1.	The project authority must adhere to the stipulations made by the concerned Assam State Pollution Control Board and the State Government and any other statutory body.	Stipulations of SPCB &state Govt. and any other statutory shall be complied.

S. No	Conditions	Status as on 31.3.2014
2.	No further expansion or modification in the project shall be carried without prior approval of the Ministry of Environment and Forests. In case of deviation or alterations in the project proposal from those submitted to the Ministry for clearance, a fresh reference shall be made to the Ministry.	Expansion or modification ISOM unit shall not be done without prior approval of Ministry. **Complied**
3.	At no time, the emissions should go beyond the prescribed standards. In the event of failure of any pollution control system, the respective well site should be immediately put out of operation and should not be restarted until the desired efficiency has been achieved. Provision of adequate height of stack attached to DG sets & flare is to be done.	**Complied**. To meet the prescribed standards, online and manual monitoring systems are set. There are no well sites in the Refinery.
4.	Waste water shall be properly collected and treated so as to conform to the standards prescribed under EP Act & Rules and mentioned in the Consents provided by the relevant SPCB.	**Complied.** Wastewater is properly collected and treated in ETP through physical, chemical and biological process to conform to the standards.
5.	The overall noise levels in and around the premises shall be limited within the prescribed standards (75 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz 75 dBA (day time) 70 dBA (night time)	**Complied.** Regular noise level monitoring is done and observations are within the prescribed limits. Observations are attached as **Annx-V.** **Complied.** Regular ambient noise level monitoring is done and observations are within the prescribed limits

S. No	Conditions	Status as on 31.3.2014
6.	The project authorities must 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 etc. Necessary approvals from Chief Controller of Explosives must be obtained before commission of the expansion project, if required. Requisite On-site and Off-site Disaster Management Plans will be prepared and implemented.	**Complied.** Provisions of MSIHC rules, 1989 and amendments are strictly followed. Requisite On-site and Off-site Disaster Management Plans are prepared and followed.
7.	Handling of Hazardous Waste shall be as per the Hazardous Waste (Management and Handling Rules 2003). Authorization from the State Pollution Control Board must be obtained for collections, treatment, and storage disposal of hazardous wastes.	**Complied.** Present authorization is valid up to 27th August 14.
8.	The project authorities will provide adequate funds as non-recurring and recurring expenditures to implement the conditions stipulated by the Ministry of Environment and Forests as well as the State Govt. along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purposes.	**Complied.**
9.	The company shall develop rainwater-harvesting structures to harvest the runoff water for replacement of ground water.	**Complied.**
10.	The concerned Regional Office of this Ministry/ Central Pollution Control Board/ State Pollution Control Board will monitor the stipulated conditions. A six monthly compliance report and the monitored data should be submitted to them regularly. It will also be displayed on the website of the company.	Stipulations are being **complied** and updated in the website " www.iocl.com"

S. No	Conditions	Status as on 31.3.2014
11.	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/ Committee and may also be seen at Website of the Ministry of Environment and Forests at http:/WWW.envfor.nic.in. This should be advertised within seven days from the date of issue of the clearance letter at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the concerned Regional Office of this Ministry.	**Complied.** Guwahati Refinery informed the public that the project has been accorded environmental clearance by MoE&F through the daily English paper 'The Sentinel' and the local language paper the 'Dainik Assam' on 25th March'08.
12.	A separate environment management cell with full-fledged laboratory facilities to carryout various management and monitoring functions shall be set up under the control of Senior Executive.	**Complied.** Separate environment management cell headed by DGM exists. Laboratory facility is available in the refinery.
13.	The Project Authorities shall inform the Regional Office as well as the Ministry the date of financial closure and final approval of the project by the concerned authorities and the date of start of the project.	Complied

Annexure -I

Data on Stack Emission Monitoring at Guwahati Refinery
(Oct'13-Mar'14)

Stack	Concentration (mg/NM3)		
	PM	SO2	NOX
CDU	73-96	440-520	134-229
DCU	35-88	256-503	99-195
TPS Boilers			
Blr 5	49-70	421-595	133-216
Blr 6 & 7	36-70	476-709	176-309
HDT	21-57	42-131	68-197
HGU	24-47	103-321	73-122
INDMAX	63-85	94-236.	90-141
ISOM	21-45	32-196	116.-159

Annexure-II

Data on Ambient Air Monitoring at Guwahati Refinery
(Oct'13-Mar'14)

Values in ug/m3

AMBIENT AIR QUALITY MONITORING REPORT

Sampling and analysis done by M/S Mitrask pvt. Ltd.,Kolkata

	Concentration of Pollutants											
	SO2	NO 2	PM 10	PM 2.5	Ozone (O3)	Lead (Pb)	CO	Ammonia (NH3)	Benzene (C6H6)	Benzo(O) Pyrene	Ars enic (As)	Nickel (Ni)
	μg/m3	μg/ m3	μg/m3	μg/m3	μg/m3	μg/m3	mg/m3	μg/m3	μg/m3	ng/m3	ng/ m3	ng/m3
Limit as per CPCB notification, New Delhi,18th Nov, 2009.for Ambient air quality	80	80	100	60	100	1	2	400	5	1	6	20
Location : Admn Building												
Max.	12.4	56.8	97.0	58.0	BDL	0.10	1.0	68.5	5.0	BDL	BDL	18.7
Min.	4.6	22.6	55.0	29.0	BDL	0.01	0.5	22.0	3.6	BDL	BDL	4.8
Avg.	7.7	36.1	80.6	43.3	BDL	0.01	0.8	33.4	3.9	BDL	BDL	10.4

Location : Guest House											
Max.	10.2	54.9	96.0	58.0	BDL	0.05	0.9	57.2	3.5	BDL	BDL	15.9
Min.	4.2	21.6	45.0	24.0	BDL	0.01	0.4	20.2	3.3	BDL	BDL	5.3
Avg.	6.2	32.7	72.6	39.1	BDL	0.02	0.6	31.8	3.3	BDL	BDL	9.8
Location : Sector II												
Max.	12.7	56.7	99.0	58.0	BDL	0.08	1.0	48.3	4.8	BDL	BDL	18.7
Min.	4.5	23.6	52.0	27.0	BDL	0.03	0.3	17.5	3.3	BDL	BDL	5.5
Avg.	7.6	36.8	80.9	44.4	BDL	0.03	0.7	30.8	3.6	BDL	BDL	10.8
Location : WTP												
Max.	8.5	40.5	88.0	50.0	BDL	0.04	0.8	48.3	0.0	BDL	BDL	12.2
Min.	4.0	17.5	42.0	23.0	BDL	0.00	0.2	20.0	0.0	BDL	BDL	3.3
Avg.	5.4	28.2	65.6	34.8	BDL	0.02	0.4	28.9	0.0	BDL	BDL	7.7
	Detection Limit of O3 : 19.62 µg/m3,Pb : 0.02 µg/m3, Ni: 1.0 ng/m^3 As : 2 ng/ m3 , C_6H_6: 2.8 µg/m3 , Benzo(a)pyrene : 0.2 ng/m3 .											

Annexure III

RESULTS OF FUGITIVE EMISSION MONITORING

AT GUWAHATI REFINERY FOR ((Oct'13-Mar'14)

Fugitive Emission

		H2U & HDT	Boiler 6&7	CDU	SRU	DCU
Oct-13	Total HC(ppm)/Benzene (mg/m3)	0.85/0.0585	0.096/0.0305	2.05/0.102	2.32/0.0895	1.23/0.085
Nov-13	Total HC(ppm)/Benzene (mg/m3)	1.15/0.066	1.06/0.044	3.09/0/.112	3.67/0.097	3.1/0.092
Dec-13	Total HC(ppm)/Benzene (mg/m3)	2.2/0.054	0.75/0.02431	3.18/0.177	2.79/0.094	3.93/0.105

		H2U & HDT	Boiler 3&4	CDU	SRU	DCU
Jan-14	Total HC(ppm)/Benzene (mg/m3)	3.77/0.129	5/0.1	4.1/0.088	2.82/0.0667	1.23/0.085
Feb-14	Total HC(ppm)/Benzene (mg/m3)	4.62/0.146	3.91/0.088	5.97/.103	3.86/0.097	6.85/0.154
Mar-14	Total HC(ppm)/Benzene (mg/m3)	6.37/0.198	5.34/0.171	8.31/0.132	7.68/0.201	9.63/0.237

Annexure-IV

Data on Discharged Effluent Analysis at Guwahati Refinery (Oct'13-Mar'14)

Sl. No.	Parameter	Concentration value (mg/l except pH)	Concentration value (mg/l except pH)	%age Compliance
	-	National Limit	Average	
1	pH	6.0 – 8.5	7.05	100
2	Oil & Grease	5	2.38	100
3	BOD	15	6.62	100
4	COD	125	17.40	100
5	TSS	20	13.66	100
6	Phenols	0.35	0.07	100
7	Sulphides	0.5	0.01	100
8	CN	0.2	0.01	100
9	Ammonia as N	15	2.71	100
10	TKN	40	6.79	100
11	P	3	0.26	100
12	Cr (Hexavalent)	0.1	0.05	100
13	Cr (Total)	2	0.01	100
14	Pb	0.1	0.01	100
15	Hg	0.01	0.00	100
16	Zn	5	0.05	100
17	Ni	1	0.01	100
18	Cu	1	0.02	100
19	V	0.2	0.20	100
20	Benzene	0.1	0.01	100
21	Benzo (a) -Pyrene	0.2	0.01	100

Load Mass Based Effluent data

(Oct'13-Mar'14)

Figs in Kg/1000 tonnes crude

Sl. No.	Parameter	Quantum value (kg/TMT of Crude processed)	Quantum value (kg/TMT of Crude processed)
		National Limit	Average
1	pH	--	--
2	Oil & Grease	2	0.409
3	BOD	6	1.134
4	COD	50	2.895
5	TSS	8	2.358
6	Phenols	0.14	0.013
7	Sulphides	0.2	0.002
8	CN	0.08	0.002
9	Ammonia as N	6	0.508
10	TKN	16	1.241
11	P	1.2	0.040
12	Cr (Hexavalent)	0.04	0.008
13	Cr (Total)	0.8	0.002
14	Pb	0.04	0.002
15	Hg	0.004	0.000
16	Zn	2	0.005
17	Ni	0.4	0.002
18	Cu	0.4	0.003
19	V	0.8	0.014
20	Benzene	0.04	0.001
21	Benzo (a) -Pyrene	0.08	0.001
	Effluent discharge,M3/TMT of crude processed	400/700	166

Annexure - V

NOISE LEVEL MONITORING
BATTERY AREA
GUWAHATI REFINERY(Oct'13-Mar'14)

NOISE LEVEL MONITORING REPORT FOR THE MONTH OF OCT-MAR 2014

NO. MED/OHC/2014/

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		Air Compressor Area	1.30 hrs	93.0
		DCU Field Control Room	8.0 hrs	67.5
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		Air Compressor 013-K-01B	1.00 hr	OFF
		Air Compressor 013-K-01C	1.00 hr	OFF
		Nitrogen Field Control Room	8.0 hrs	63.5

5	INDMAX	Main Air Blower Area	1.00 hr	96.0
		INDMAX Field Control Room	8.0 hrs	64.5
6	SRU	Main Air Blower 51A-K-01A	1.30 hrs	OFF
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9	MSQU	Pump Area	1.00 hr	95.0
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Permissible Noise Level For Continuous Exposure (OISD-GDN-166, JULY 1997.)

DURATION PER DAY (HOURS)	SOUND LEVEL (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
1/2	110
1/4 or less	115

ANNEXURE-VII:

RISK ASSESSMENT

ANNEXURE-VIII:
DISASTER MANAGEMENT PLAN

Indian Oil

INDIAN OIL CORPORATION LIMITED

Disaster Management Plan

FOR

Proposed revamp of 150 TMTPA INDMAX Unit at Guwahati, Refinery Assam

Submitted To

INDIAN OIL CORPORATION LIMITED
Refineries Division, Guwahati Refinery,
Maniram Dewan Road, Noonmati, Guwahati
Assam-781020

March-2015

Prepared By

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CHAPTER-1: INTRODUCTION

1.1 BACKGROUND

Disaster Management planning is an integral and essential part of loss prevention strategy. Although a great deal of efforts and money is spent to reduce the scale and probability of accidents, there always remains a finite but small possibility that disaster may occur. Effective action has been possible due to existence of pre-planned and practiced procedures for dealing with emergencies.

This disaster management plan sets out the procedures and measures to be taken into account in the event of loss of containment and consequence thereof in the INDMAX Unit Guwahati Refinery

1.2 TYPES OF EMERGENCIES

The type of emergency primarily considered here is the major emergency which may be defined as one which has the potential to cause serious danger to persons and/or damage to property and which tends to cause disruption inside and/or outside the site and may require the co-operation of outside agencies.

Emergency is a general term implying hazardous situation both inside and outside the factory/installation premises. Thus the emergencies termed “on-site” when it confines itself within the factory/installation even though it may require external help and ‘offsite” when emergency extends beyond its premises. It is to be understood here, that if an emergency occurs inside the plant and could not be controlled properly and timely, it may lead to an “off-site” emergency.

An emergency in the Refinerycan arise due to certain undesired incidents resulting in fire, explosion or oil spill.

1.2.1 Definition of On-Site Emergency and Off-site Emergency

An On-site emergency is one where the consequences of an undesired incident remain confined within the boundaries of the facility. Emergencies at the Refinery shall be On-Site Emergencies if the consequences remain confined within the boundaries.

An emergency, which is likely to develop or has developed such as to pose a threat to members of public outside the facility boundary, is termed as an off-site emergency. All mainline emergencies shall be Off-site emergencies. Emergencies at the Refinery shall be Off-Site Emergencies, if the consequences exceed the boundaries.

1.2.2 Classification of Emergencies

Emergencies have been broadly classified into three levels:

Level 1 : The incident at Refinery is confined to a small area and does not pose an immediate threat to life or property.

Level 2 : An incident at Refinery involving a greater hazard or larger area which poses a potential threat to life or property.

Level 3 : An incident at Refinery involving a severe hazard or a large area which poses an extreme threat to life or property.

1.2.3 Priority in Emergency Handling

The general order of priority for involving measures during the course of emergency would be as follows:

- Safeguard life
- Safeguard environment
- Safeguard property

1.3 SPECIFIC OBJECTIVES OF THE DISASTER MANAGEMENT PLAN

The internal resources in the installation like dispatch, intermediate and Refinery may be inadequate to deal with the on site situation and will require the support of outside services. It can provide resources to supplement the internal resources and deal with the situation “off-site”. They would, however, find it in some situation difficult to operate effectively in isolation from the internal resources. The objective must therefore be to make the most effective use of the combined resources to:

- Safeguard plant and outside people.
- Minimize damage to property and the environment.
- Initially contain and ultimately bring the incident under control.
- Identify casualties.
- Provide for needs of causalities.
- Provide authoritative and factual information for the news media.
- Secure safe rehabilitation of the affected area.
- Preserve relevant records and equipment for the subsequent enquiry into the circumstances and cause of the incident.
- Restore the facilities at the earliest.

The main objectives of the Disaster Management Plan would be:

- Ensure that loss of life and injuries to persons are minimized

- Damage to environment is minimized
- Property loss is minimized
- Relief and rehabilitation measures are effective and prompt
- Minimize the outage duration of the facilities.

The above objectives are sought to be achieved through some of the following measures:

- Providing information to all concerned on the estimated consequences of the events that are likely to develop as a result of the emergency;
- Mobilizing on-site resources;
- Calling up assistance from outside agencies;
- Initiating and organizing evacuation of affected workmen;
- Providing necessary first aid and other medical services that may be required;
- Collecting data on the latest developments, other information and requirements.

1.4 LEGAL AUTHORITY AND RESPONSIBILITY

1.4.1 On Site Emergency Planning

The provisions of the Hazardous Chemicals Rules, Section 41 B(4) of the Factories Act, 1948 (as amended) requires that every occupier is to draw up an on-site emergency plan with detailed disaster control measures and to educate the workers employed. The obligation of an occupier of hazardous chemicals installation to prepare an emergency plan is also stipulated in Rule 13 of the 'Manufacture, Storage and Import of Hazardous Chemicals Rule's, 1989 and amended.

1.4.2 Off-Site Emergency Planning

Under the 'Manufacture, Storage and Import of Hazardous Chemicals Rules' preparation of 'Off-site Emergency Plan' is covered in Rule No.14. The duty of preparing and keeping up to date the 'Off-site Emergency Plan' as per this rule is placed on the District Emergency Authority. Also, occupiers are charged with the responsibility of providing the above authority with such information, relating to the industrial activity under their control, as they may require for preparing the off-site emergency plan.

Off-site emergency response needs actions by various Government agencies over which the operating company has no control. IOCL's role and responsibility is to provide material, manpower, and knowledge support under the overall charge of the off-site control administration.

1.5 STRUCTURE OF THE DISASTER MANAGEMENT PLAN

This Disaster management plan basically comprises of the following elements:

- Identification of hazards and risk analysis
- Organizational Structuring, Duties and Responsibilities
- Response Procedures
- Infrastructure and Resources

1.5.1 Identification of hazards and Scenarios

The release-consequence scenarios have been summarized in Chapter 2, of DMP. Basis for selection of release scenarios for response planning has also been discussed.

1.5.2 Organizational Structuring, Duties and Responsibilities

The organization structuring, duties and responsibilities for IOCL has been described in Chapter 3 of DMP.

1.5.3 Response Procedures

The response procedures have been covered in Chapter 4 of this document.

1.5.4 Off site Emergency Plan

The organizational aspects, duties and responsibilities of various civic authorities for an Off-site emergency response have been briefly described in Chapter 5.

1.5.5 Infrastructure and Resources

These have been documented in Appendix 1.

CHAPTER-2:
SELECTION OF SCENARIOS FOR EMERGENCY PLANNING

2.1 INTRODUCTION

The primary step in any disaster management planning is identification and assessment of the principal hazards like for instance the hazards due to fire & explosion. It is the most important step without which the whole exercise of emergency planning turns out to be meaningless.

Operation experience, past histories and criteria review will help in identifying the vulnerable points and possible hazards. These are then assessed applying the appropriate risk analysis methods.

In this Chapter, the findings of the risk analysis study have been summarized. The basis for selection of scenario for emergency planning has also been discussed. The accident scenarios for planning response procedures and carrying out mock drill are suggested.

2.2 HAZARD IDENTIFICATION & SELECTION OF SCENARIOS

The hazard identification and selection of scenarios is given in RA Report of revamp of INDMAX Unit.

The hazards from INDMAX Unit critical instruments and surrounding tanks of INDMAX Unit include:

- Pool fire
- Flashfire
- Vapour cloud explosion

The causes of the spillages can be divided into following categories:

- Mechanical failure
- Operational failure
- Natural hazards
- Third party activity

At the INDMAX Unit, failure of any of the equipment such as tanks, pumps, valves, flanges, filter etc. can result in loss of containment.

The INDMAX Unit is divided into appropriate isolatable sections i.e. sections that can be promptly isolated from each other in case of emergency.

The outcome cases considered for each release case are as follows:

- Immediate ignition resulting in pool fire
- Delayed ignition resulting in flashfire/ vapour cloud explosion

Details of Damage criteria and consequence analysis is given in **Annexure-VII**

2.3 SUGGESTED ACCIDENT SCENARIOS FOR EMERGENCY PLANNING

Based on the risk analysis study and discussion on basis for scenario selection for emergency planning, the accident scenarios for planning response procedures and carrying out mock drill are suggested as follows.

For Pump Stations

- In most cases the spill will be contained within the boundary wall, therefore, for pool fire scenarios the consequences are not likely to go beyond the boundary limits.
- The INDMAX Unit nearest tanks vapour cloud for HSD and SKO spill can be formed except for unstable weather conditions such as typical day-time conditions.
- Line rupture downstream of pump, release of Oil, formation of flammable vapour cloud and possibility of delayed ignition resulting in vapour cloud explosion/flash fire/pool fire.

For Line Tanks

- For Line tanks, the 1% fatality distance (12.7kW/m^2) for clothed human body and exposure duration of 10 seconds extends. Calculations indicate that no possibilities of explosive mass from fixed pool area.

The response procedures have been detailed in Chapter 4 for various planning topic. These response procedures should be reviewed for the scenarios selected for planning. Mock Drills should be conducted regularly, and based on the results of mock drills the response procedures should be updated and/or other accident scenarios included for planning.

2.4 MOCK DRILL EXERCISES

Exercises or Drills have two basic functions, namely training and testing. While exercises do provide an effective means of training in response procedures, their primary purpose is to test the adequacy of the emergency management system and to ensure that all response elements are fully capable of managing an emergency situation.

Because drills and exercises simulate actual emergency situations, they are the best means of accomplishing the following goals and objectives:

- To reveal weaknesses in the plans and procedures before emergencies occur.
- To identify deficiencies in resources (both in manpower and equipment).
- To improve the level of co-ordination among various response personnel, departments and agencies.
- To clarify each individual’s role and areas of responsibility.

The four types of drills and exercises to test the adequacy of the plan are: (1) orientation exercises, (2) tabletop exercises, (3) functional drills, and (4) full-scale exercises. Each of these should be designed to evaluate individuals' responses to various degrees of simulated emergency conditions in order to test the adequacy of procedures.

CHAPTER-3: EMERGENCY ORGANIZATION & RESPONSIBILITIES

3.1 EMERGENCY ORGANIZATION & RESPONSIBILITIES

In case of an emergency at INDMAX Unit, the On-site Emergency Plan of the Refinery will come into action.

Effective emergency plan requires that, in the event of an accident, nominated functionaries be given specific responsibilities, often separate from their day-to-day activities.

Emergency control organization has been designed by identifying the safe transition from normal operation to emergency operations and systemic shutdown, if any, and the delegation of authority from operations personnel to emergency response personnel. For this purpose an emergency response organization with appropriate lines of authority with succession planning and actuating the response management has been formed. Responsibilities for decision making are clearly shown in the emergency organization chart.

3.1.1 EMERGENCY ORGANISATION

Overall objectives of the emergency control organization are as follows:

- To promptly control problems as they develop at the scene
- To prevent or limit the impact on other areas and offsite.
- To provide emergency personnel, selecting them for duties compatible with their normal work functions wherever feasible.
- To assume additional responsibilities as per laid down procedure of ERDMP whenever an emergency alarm sounds.
- To set up the organization for round the clock coverage in case shift personnel may need to take charge of emergency control functions or emergency shutdown systems, until responsible persons arrive at site of emergency.

3.2 EMERGENCY CONTROL CENTRE (CRISIS CONTROL ROOM):

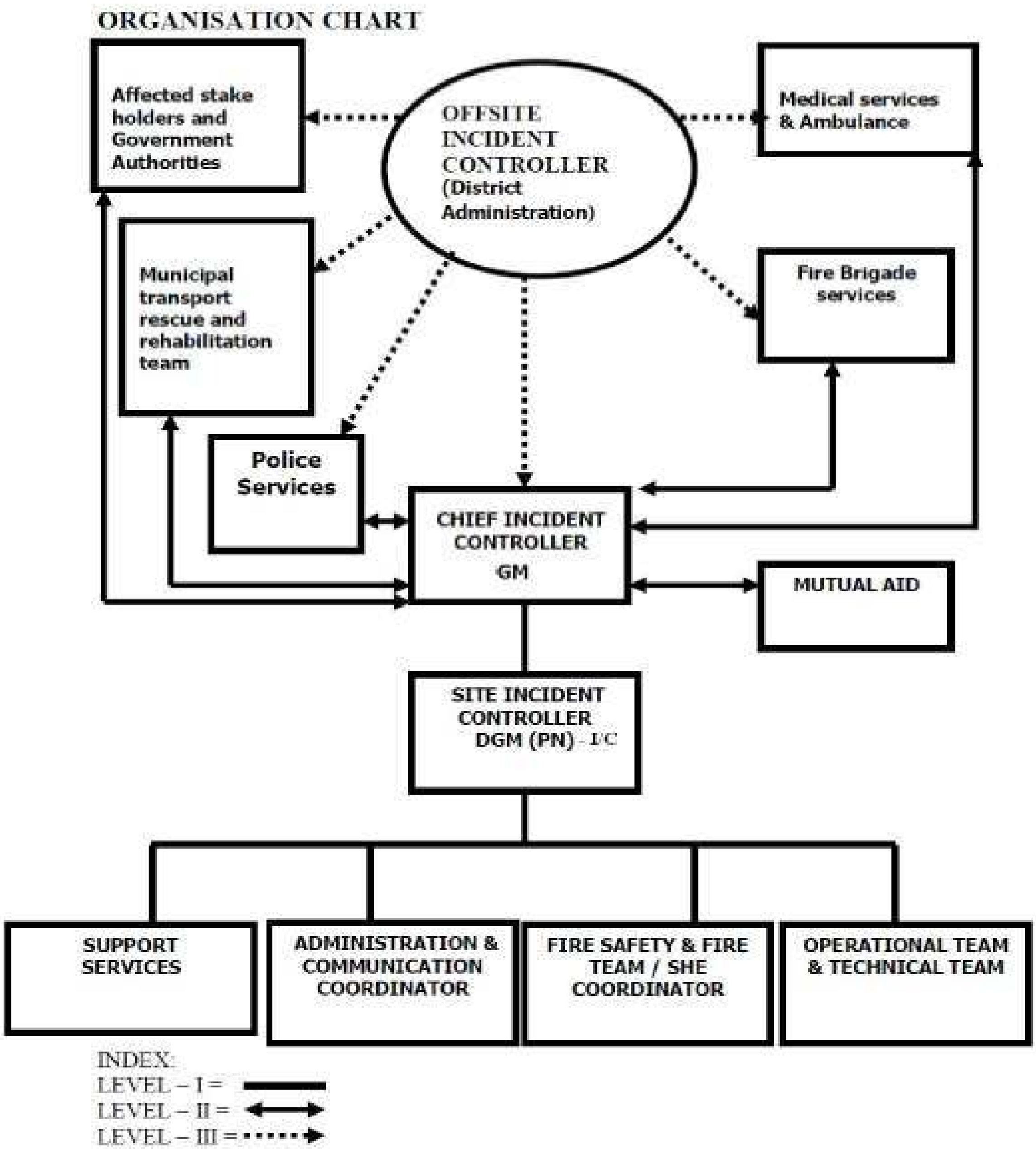
The Emergency control centre is situated at the main gate in CISF building of Guwahati Refinery. In charge of Emergency control centre is Chief Incident Controller. It is away from any sort of potential hazard of the refinery plant operations.

i) It is constructed with reinforced concrete.
ii) It has adequate ventilation and two Exit points.
iii) It has the certified copy of DMP available
iv) It has maps and diagrams/layouts of Guwahati Refinery, Site plan and plot plan indicating nearby areas.
v) It has MSDS of all chemicals used in the refinery ready for reference.

vi) It has updated list of Names, Addresses and Telephone directories of employees, offsite groups, Mutual aid partners, etc.

vii) Communication facilities, telephones, walkie-talkies, fax lines, emergency lighting, log books, and tape recorders.

viii) It has dedicated computers with LAN facility and internet facility, and updated manuals of all units.



Emergency control centre Office: 7050/ 7070 /7061/7062/7063/7064/ 2657107(BSNL) / 265704

Note: (1) Above is a typical and basic organogram for control of emergency. Entity can merge the functions as per their other statutory requirements and based on level of risk and range of operations. The organisation shall have to address all services and support system required and available to it.

(2) Support Services Include Communication Services, Engineering/Maintenance Services, Medical and Occupational Health, Human Resource and Welfare Service, Security, Media/Public Relations, Transport and Logistics, Finance, Contract and Procurement and Environmental Services.

(3) Role of both CIC and SIC can be merged depending upon the requirement.

3.3 DESIGNATED CHART OF GUWAHATI REFINERY

DESIGNATED CHART OF GUWAHATI REFINERY

TECHNICAL ADVISERS
DGM(I/C)-T
8105 (R)/7105 (O)/9435144929
DGM (TS & HSE)
8107 (R)/7107 (O)/9435144926
DGM (M&C)
8109 (R)/7109 (O)/9435144930
DGM (P&U)*
8108 (R)/7108 (O)/9435552588

CHIEF INCIDENT CONTROLLER
GM
7101/7103 (O) 8101/8103 (R)
2657017 2657018
Mob : 9435022429

ADMINISTRATION & COMMUNICATION COORDINATOR
DGM I/C(HR)
7102 (O) 8004 (R)
2657005 2657006
Mob : 9435133006

MEDIA & PR COORDINATOR
DGM (A&W)
8141 (R)/7141 (O)/9435708182

SITE INCIDENT CONTROLLER
DGM(PN) I/C (UNITS & OFFSITE)
8020 (R)/7104 (O)/9435110252
DGM (P&U) * (TPS& Utilities)
8108 (R)/7108 (O)/9435552588

INCIDENT CONTROLLER
RSM
Office :7411 / 7422/2657141

EMERGENCY RESPONSE COORDINATOR
CM (HSE)
7346(O)/9435122728

OPERATIONS COORDINATOR
DGM (PN) (UNITS & OFF SITE) -7110 (O)/9435137430
CPUM * (TPS & Utilities)
8701 (R)/7701 (O)/9435020638

FIRE FIGHTING & RESCUE COORDINATOR
CFSM
8501 (R)/7501 (O)/9435709883

MAINTENANCE COORDINATOR
DGM (INST)- 8651 (R)/7651 (O)/9435020205
CMNM - 8601 (R)/7601 (O)/9435119873
SMNMCL (I/C)- 7872 (O)/9435492913

MEDICAL COORDINATOR
CMO
8531 (R)/7531 (O)/9435406919

UTILITIES & COMMUNICATION COORDINATOR
CPUM- 8701 (R)/7701 (O)/9435020638
CMNMEL- 8702 (R)/7702 (O)/9435021804

TRANSPORT & WELFARE SERVICES COORDINATOR
CHRM
7111 (O)/9435108707

PROJECT SITE COORDINATOR
CPJM
7951 (O)/9435023214

SECURITY & TRAFFIC COORDINATOR
DC (CISF)
8901 (R)/7901 (O)/9435144927

MATERIALS COORDINATOR
CMTM
8251 (R)/7251 (O)/9435709381

FINANCE COORDINATOR
CFM
7201 (O)/9706007559

PIPE LINE COORDINATOR
COM

Note : * If disaster takes place at TPS & Utilities

1) DGM (Security) shall be present in CCR to assist Security and Traffic Co-ordinator.

2) Information to be given to Pipe line Co-ordinator in case of exigency.

3) In case of two contigencies simulatneously, DGM (I/C)-T will act as chief incident controller for sencond contigency and alternate site cordinators shall respond for second contgency. Disaster control room and chief main cordination group shall be common for both the contgencies.

3.4 SUCCESSION CHART

SUCCESSION CHART OF GUWAHATI REFINERY

TECHNICAL ADVISERS
CTSM-II -7303 (O)/9706078807
CTSM-III -7302 (O)/9435120298

CHIEF INCIDENT CONTROLLER
DGM (T) I/C
7105 (O) 8105 (R)
2657011 2657012
Mob : 9435144929

ADMINISTRATION & COMMUNICATION COORDINATOR
DGM (A&W)
7141 (O) 8141 (R)
2657003 2657261
Mob : 9435708182

MEDIA & PR COORDINATOR
CM (A&W, CSR)
7127 (O)

SITE INCIDENT CONTROLLER
DGM(PN) (UNITS & OFFSITE)
7104 (O) /9435137430
CPUM * (TPS & Utilities)
8701 (R)/7701 (O)/9435020638

INCIDENT CONTROLLER
RSM
Office :7411 / 7422/2657141

EMERGENCY RESPONSE COORDINATOR
M (Safety)
7341 (O)/9435528576

OPERATIONS COORDINATOR
SPNM (Units) /SPNM (Off site)/
SPUM * (TPS & Utilities)

FIRE FIGHTING & RESCUE COORDINATOR
DMFS (NC)
8505 (R)/7504 (O)/9435553352

MAINTENANCE COORDINATOR
SMNMML- 7602 (O)/9954095639
ITM (PW)- 8652 (R)/7652 (O)/8811047960
ITM (VSJ)- 7653 (O)
MNMCL (PKG) - 7874 (O)/8874 ®/

MEDICAL COORDINATOR
ACMO (BK)
8535 (R)/7535 (O) /9435492468

UTILITIES & COMMUNICATION COORDINATOR
SPUM-8704(R)/7704 (O)/9436436171
SMNMEL-7703 (O)/9435529813

TRANSPORT & WELFARE SERVICES COORDINATOR
SHRM (C Sarma)
7127 (O)/9435035494

PROJECT SITE COORDINATOR
PJM (BCD)
7954 (O)/9435340409

SECURITY & TRAFFIC COORDINATOR
AC (CISF)

MATERIALS COORDINATOR
SMTM (P)
7252 (O)

FINANCE COORDINATOR
SFM
7202 (O)

PIPE LINE COORDINATOR
DMO (NB)
7047 (O)/9864059533

Note : * If disaster takes place at TPS & Utilities

The emergency organization follows the usual pattern of the hierarchy. The senior-most functionary available during an emergency at the Refinery takes charge as **Chief Emergency Coordinator (CEC)** and will locate himself at the designated Primary Command Post. The senior most functionaries for each emergency service will act as coordinator and shall report at the Primary Command Post unless otherwise instructed by the Chief Coordinator.

The senior most person (operations) in the shift is designated as the **Site Incident**

Controller (SIC). The SIC takes charge of the incident site and takes the overall command. He is supported by other Key persons representing various emergency services. **Key persons** are personnel available at the site on round the clock basis. It is to be appreciated that the Key Persons remain the front line fighters. The role of various **coordinators** is to assess the situation from time to time, take appropriate decisions in consultation with the CEC and to provide timely resources to the Key Persons to fight the emergency.

Emergency planning also requires coordination with Head Office, Regional Office and other Refinery/ Refinerys around the Refinery. The main functionary at head office has been designated as **Crisis Coordinator (HO)**. The main functionary at Regional office has been designated as **Crisis Coordinator (RO)**.

Duties and responsibilities of various emergency functionaries have been described in following sub sections. The organizational aspects, duties and responsibilities of various civic authorities for an Off-site emergency response have been given in Chapter 5.

3.5 EMERGENCY CONTROL CENTER (ECC)

LOCATION : CISF building at the main gate

Alternate location : GR Training center

(This is in case Administration Building falls within the disaster zone.)

3.5.1 INFORMATION CENTRE :

For Refinery : Time Office

For Township : Estate Office

3.5.2 EMERGENCY CONTROL CENTER - RESOURCE REQUIREMENT

EVACUATION & SHELTERING:
FOR INSIDE BATTERY AREA:
The entry of contract personnel working inside the battery area is through Main Gate as well as through Project Gate. In case of emergency / major accident / disaster, 4 nos. of assembly points have been identified and marked in the refinery area for assembling of people for head counting / transportation to a safe place Assembly points are located at :
Plant Canteen
Emergency control centre
Admin building
OM & S control room
All of them are situated in Safe zones.
All of them are marked with directional displays and fluorescent marking.
Pre-designated incharges of assembly points are available to take control of the assembly point in case of any emergency.
In sub section 3.3 below, names of the designated coordinators for Guwahati Refenery have been listed.

3.6 DUTIES AND RESPONSIBILITIES FOR FUNCTIONARIES

The duties and responsibilities of the functionaries are given below:

3.6.1 Crisis Coordinator (HO)

To establish emergency control center at Head Office.

To supply manpower from Head office as required by CEC.

To arrange mobilization of material and equipment from other units and outside agencies as required by CEC.

To contact crisis cell of the ministry and inform about the incident, magnitude of disaster, combating operations and number of casualties if any.

v. To approve release of information to press, TV and Government agencies.

3.6.2 Crisis Coordinator (RO)

To establish emergency control center at Regional Office.

To supply manpower from Regional office as required by CEC.

To coordinate with other stations and outside agencies, to arrange mobilization of material and equipment as required by CEC.

3.6.3 Chief Emergency Coordinator (CEC)

He will report at the command post and will assume overall responsibility of the works and its personnel. His duties are:

To assess the magnitude of the situation and decide whether a major emergency exists or is likely to develop, requiring external assistance. To inform District Emergency Authority (DEA). (i.e. District Collector) in case on-site emergency escalates into off-site emergency.

To exercise direct operational control over areas in the pump station other than those affected.
To assess the magnitude of the situation and decide if personnel need to be evacuated to identify safe places.
To continuously review in consultation with the other coordinators.
To liaise with senior officials of Police, Fire Brigade, and Factories Inspectorate and pass on information on possible effects to the surrounding areas outside the factory premises.
To liaise with various coordinators to ensure casualties are receiving adequate attention and traffic movement within the pump station is well regulated.
To arrange for a log of the emergency to be maintained in control room.
To release authorized information to press through the media officer designated.
To control rehabilitation of the affected persons and the affected areas after the emergency.
To obtain assistance from Mutual Aid partners.

3.6.4 Site Incident Controller

He will take overall control of handling the emergency at site. His first task will be the isolation of the source of containment loss to the extent feasible. Simultaneously, in case of fire, he will organize appropriate fire response to get the situation under control and to prevent escalation.

On arrival at the site he will assess the scale of emergency and judge if a major emergency exists or is likely to develop and will inform the control room accordingly asking for assistance and indicating the kind of support needed. His duties and responsibilities include:

To coordinate the activities of other key persons reporting at the incident site, under his overall command.
To direct all operations within the affected areas giving due priorities for safety of personnel and to minimize damage to environment, plant and property.
To provide advice and information to Fire & Safety personnel and other fire services as and when they arrive.
To ensure that all non-essential workers and staff within the affected area are evacuated to appropriate assembly points and those areas are searched for casualties.
To organize rescue teams for any casualties and to send them to safe areas/medical centre for first aid and medical relief.
To setup communication points and establish contact with control room.
To seek additional support and resources as may be needed through the control room.
To seek decision support from the control room for decisions such as activation of mutual aid plan etc.
To preserve all evidence so as to facilitate any inquiry into the cause and circumstance, which caused or escalated the emergency. (to arrange photographs, video etc.)
To arrange for a head count after the emergency is over with respect to the personnel on duty in the affected areas.

3.6.5 Fire and Safety Functionary

The main responsibilities of fire and safety functionary are:
To immediately take charge of all fire fighting operations upon sounding of the alarm.
To instruct the telephone operator to immediately inform all essential personnel not residing within the audible range of the emergency siren.
To guide the fire fighting crew and provide logistics support for effectively combating the fire.
To barricade the area at appropriate locations in order to prevent the movement of vehicular traffic.
To assist in rescue and first aid operations.
To operate the Mutual Aid Scheme and call for additional external help in fire fighting via the control room.
To organize relieving groups for fire fighting.
To inform the CEC and give "All Clear" signal when the fire emergency is over.

3.6.6 Engineering Functionary (Maintenance)

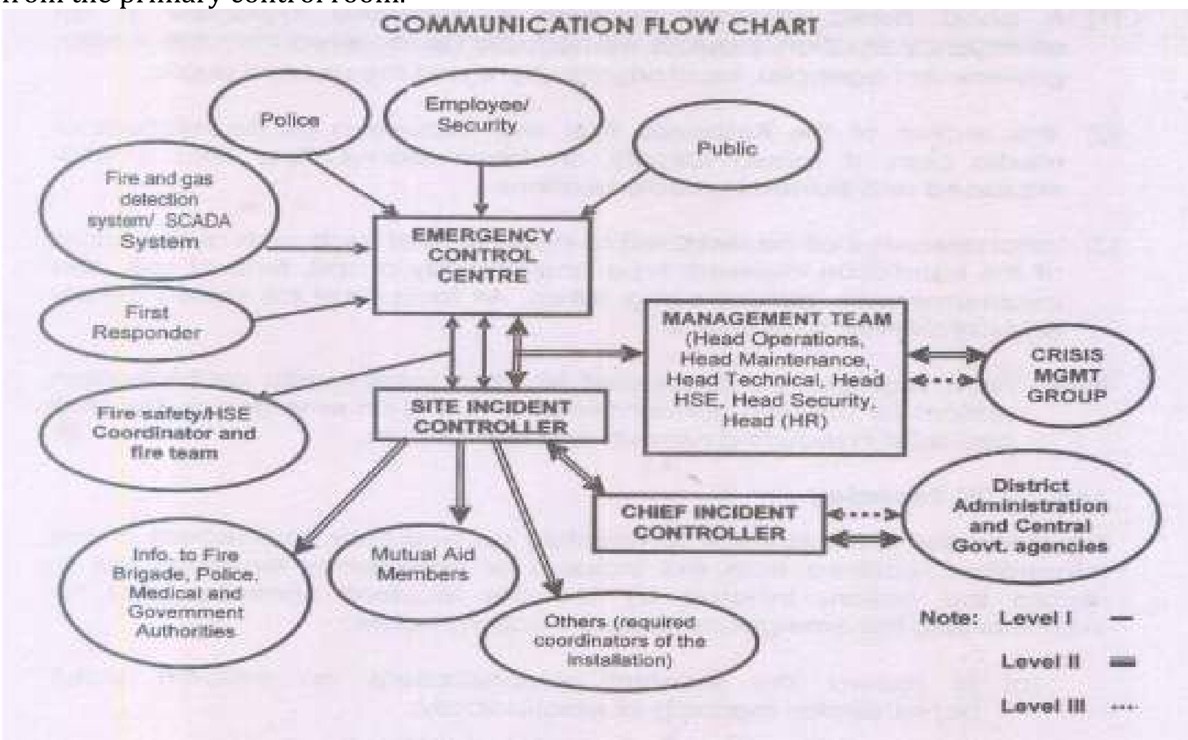
The engineering functionary will perform the following duties:

To report at the control room.
To mobilize the team from Maintenance Department to assist the Site Incident Controller.
To arrange isolation of electric lines from distribution points/substations as required by the Site Incident Controller by calling the electrical engineers/ electricians.

To provide all other engineering support as may be required.

3.6.7 Communication Functionary

Communication functionary should perform the following duties:
To ensure all available communication links remain functional.
To quickly establish communication links between incident site and the control room
To ensure that previously agreed inventory of various types of communication equipment is maintained in working condition and frequent checks carried out and records maintained.
To maintain voice record of significant communications with timings received/passed from the primary control room.



COMMUNICATION FACILITIES

The various communication facilities available at Guwahati Refinery are :

1. Plant communication system (paging system)
2. Walkie Talkie (wireless) system
3. Loud speaker announcing system
4. EPABX Telephone system
5. External DOT phones
6. Mobile /Cellular Phones.
7. Fire Alarm Systems
8. Sirens
9. Air Raid Protection (ARP) system

The Plant communication (Paging System) has been installed at he New DCS Control Room and covers all the Process Units and TPS

1.Plant communication System

Make : M/S Industronics (Germany)
Model : INTRON-D
Year of procurement : 2001
No. of points installed : **For Process Units**
Master call stations at New DCS control room to 75 Field call stations at CDU,ISOSIV , DCU , H2 , HDT , N2 , SRU , INDMAX
For TPS
Master Stations and 21 Field Cal stations
Present status : System is presently in use and fully operational
Planned/envisaged : None

2. WIRELSS SYSTEM

Make : MOTOROLA
No. of sets installed : 127 portable walkie-talkies, 21 fixed/mobile stations fitted in Control Rooms / Security Vehicles & Fire Tenders and 1 Repeater station at DCU Coke chamber top
Year of procurement : 10 portable sets & 7 mobile sets procured in 1996 Additional 20 sets procured in 1998 along with Repeater station. Additional 30 handheld sets & 3 Fixed sets procured in May 2001. Additional 22 hand held and fixed sets processed in June 2004.Additional 45 hand held sets in 2006
Present status : System is in operation

3. EPABX TELEPHONE SYSTEM

Make : AVAYA GLOBAL CONNECT
No. of EPABX : DEFINITY G3Si installed at Administration Building with installed capacity of 1048 lines
Year of procurement : Procured in 2000 and upgraded in 2005
Present status : System is in operation.

- 7 Junction lines provided for “0” dial facility to select EPABX numbers.

2 MBPS stream (30 circuits) for incoming Level DID i.e. level 2597xxx Augmentation

Planned/envisaged **:** None

4. EXTERNAL DOT PHONES

There are a total of **116** external DOT lines provided at various locations including residences of Senior Managers and Above. STD /ISD facility has been provided with approval of Management wherever necessary. The breakup of the connections are as follows :-

- Offices / Residences-------------------- 99
- FAX connections ----------------------- 5
- ‘O’ dial facility-------------------------- 7

- VIP nos.---------------------------------- 3
- Spare lines------------------------------- 2

- In addition there is a HOTLINE facility between our Fire Station and the City Fire Station at Pan Bazar.

- Cordless phones have been provided at residences of HODs and above.

- Caller Line IDs have also been provided both at office as well as residence of Senior Managers and above and also to other officers on need based

5. AIR RAID PROTECTION SYSTEM (ARP)

- Providing simultaneous ring to 24 subscribers

- The ARP system covers 24 subscribers of our EPABX Exchange

- This system can be activated from Fire Station Control Room through the Auto Telephone No. 7510 by dialing the digits 199.

- The caller has to make his message loud & clear and repeat it several times for about 15-20 seconds.

- This is a one way communication. The subscribers to the system can only hear the message and cannot answer back.

LIST OF SUBSCRIBERS TO THE ARP SYSTEM

LIST FOR ARP			
S No.	**Designation**	**Office**	**Residence**
1	GM	7101	8101
		7103	8103
2	DGM(I/C)-T	7102	8102
3	DGM(TS & HSE)	7104	8104
4	DGM (P&U)	7105	8105
5	DGM (M & C)	7106	8106
6	DGM (PN) I/C	7107	8107
7	DGM I/C (HR)	7108	8108
8	DGM (PN)	7109	
9	DGM (CC,CSR)	7141	8141
10	DGM (MN)	7651	8651
11	CFSM	7501	8501
12	CTSM-I	7301	
13	CTSM-II	7303	
14	CPUM	7701	8701
15	CIPM	7841	8841
16	CM (IS)	7115	8115
17	CM (HSE)	7346	
18	DMFS (NC)	7504	8505

19	CMNMML (APK)	7601	8601
20	CMNMML (KD)	7602	
21	SMNMCL (I/C)	7872	
22	ITM (PW)	7652	8652
23	ITM (AB)	7662	
24	CMO	7531	8531
25	ACMO (BK)	7535	8535
26	CPJM	7951	
27	PJM (MM)	7955	8955
28	CMTM	7251	8251
29	CFM	7202	
30	CM (SECURITY)	7112	8112
31	DC (CISF)	7901	8901
32	AC (CISF) (ADM) (GG)	7903	8903
33	AC (CISF) (PLANT) (DKN)	7902	8902
34	CHRM	7121	
35	SHRM (DJB)	7122	
36	SHRM (CS)	7127	
37	SMNMEL	7703	
38	SPUM	7704	8704
39	SPNM (OFFSITE)	7403	8403
40	SPNM (OLD UNITS)	7404	8404
41	PNM (New units)	7481	8481
42	DM(CC)	7142	
43	MNMEL	7707	8707
44	EPABX	7000	
45	NEW DCS CR	7460	
46	OM & S C/R	7490	
47	HOS-SIS, DUTY	7585	
48	TPS C/R	7710	
49	TELECOM	7753	
50	CISF C/R	7910	

LIST OF WALKIE TALKIES
PRODUCTION

UNIT	BASE STATION	WALKIE TALKIE
INDMAX	1	5
CDU	1	3
DCU	1	1
HDT	1	4
SRU/N2	1	3
HGU	1	2
MSQ	-	3

OM&S	-	5
RSM	-	1
SPNMs / PNMs	-	5

OTHERS

UNIT	BASE STATION	WALKIE TALKIES
FIRE AND SAFETY	4	8
HODs & ABOVE	-	10
TPS	-	11
INSTRUMENTATION	-	2
ELECTRICAL MAINTENANCE	-	4
MECHANICAL MAINTENANCE	-	2
CISF / CRISIS C/R	4	23
QC LAB	-	2
BASE STATION (DCU TOP)	2	-
SPARE / FAULTY	5	37

3.6.8 Medical Functionary

The medical functionary will perform the following:
To arrange for the First Aid team to treat the affected personnel.
To arrange for treatment in the hospital.
To liaise with the local medical authorities and hospitals, if the casualties are more and the situation demands treatment at more/other medical centers.
To liaise with the Transport coordinator for transporting the victims to various hospitals. To arrange for ambulances.
The Medical Coordinator should ensure the upkeep of agreed medical supplies, antidotes and equipment that should always be kept in stock for treating victims of burns.
To liaise with the Media coordinator for release of news to the press.

3.6.9 Transport Functionary

The Transport functionary shall perform the following duties

Arrange for Transport of victims to Hospital/Dispensaries
Mobilize all available vehicles available at the pump station for emergency use, along-with the drivers.
Arrange for the duty rotation of the drivers to meet with the emergency situation.

To direct refueling of vehicles, if not topped up.
To arrange for vehicles from Other Sources.
To liaise with the CEC for evacuation of personnel and transportation of victims.

3.6.10 Security Functionary

The Security functionary shall perform the following duties:

To control traffic movement in/out of the pump station. To instruct plant security personnel to maintain law and order and prevent unnecessary gathering of personnel not required to be present at the scene of emergency.
To instruct security personnel, who could be spared, to assist Fire & Safety Coordinator in fire fighting or evacuation of personnel.
To request for external help/local authorities, if needed, through control room.

3.6.11 Materials Functionary

The Materials functionary will ensure:

Availability of materials required by the Site Incident Controller.
Issue of materials from warehouse round-the-clock during the emergency period.
Emergency procurements from local dealers or from neighboring industries.
Transportation of Materials from warehouse to the incident site in Co-ordination with Transport Coordinator.

3.6.12 Finance Functionary

The Finance functionary shall arrange for:

Release of finance as directed by the CEC.
Assist Material Coordinator for emergency procurement.
Liaise with Insurance Company personnel.

3.6.13 Welfare Functionary

Ensure that Casualties receive adequate attention and to arrange additional help (compensation, etc.) if required and inform the relatives.

3.6.14 Mainline Search Party Leader

The mainline search party leader shall perform the following functions:

Lead the search of the location of leak
Assess the magnitude of the leak and give feed back to CEC for further assistance / mobilization.
Act as Site Incident Controller (until the SIC designated by CEC reaches the incident site).
Arrange to isolate the section of the mainline where leak is detected.

Note- Plans shall also be developed to utilize local media and television stations for periodic announcements during an emergency. This shall also assist in reducing rumours and speculation.

SL. No.	Check-Point	Yes ☐ No ☐ ☐ Remarks
1.	Frequency of mock-drills for practice, refinement and updation	Once a quarter
2.	Are the records for periodic Mock drills maintained in a well defined format	Yes
3.	After each drill, whether assembly meetings involving all staff and contract personnel are conducted to share experience of the event as also to identify the shortcomings and scopes for further improvement in procedures. Whether the issues are discussed and the plan modified suitabily	Yes
4.	Does the review ensures efficiency of the plan particularly w.r.t. response, communication and coordination aspects	Yes
5.	Do the Mutual Aid members participate in the drills and based on the actual response and difficulties experienced, corrective actions initiated for refinement of the plan	Yes, during offsite drills
6.	Does a procedure exist in incorporating the findings / learning of the actual disaster management handling, if any so that the plan can be revised accordingly	Yes

3.7 SIREN CODES:

Six nos. of fire sirens of 5KW range are installed at different locations, inside as well as outside refinery.

SL.NO.	LOCATION	AREA
1.	Administrative Building	Inside refinery
2.	Quality Control Laboratory	Inside refinery
3.	OM&S	Inside refinery
4.	New DDCS	Inside refinery
5.	Sector-I	Outside refinery

6.	Sector-III	Outside refinery

These are audible to all personnel of refinery and township. Sirens are regularly tested daily at 07.45 hrs from fire station by sounding straight for two minute. In addition to that Disaster siren is tested on first day of month.
As per OISD Guidelines –116, Fire siren code should be as follows:

1. SMALL FIRE: No siren
2. MAJOR FIRE (EMERGENCY LEVEL 1): A wailing siren for two minutes. Sirens will be sounded three times for thirty seconds with an interval of fifteen second in between.
3. DISASTER (EMERGENCY LEVEL 2 AND 3): Same type of siren as in case of Major Fire but the same will be sounded for three times at the interval of two minutes.
4. ALL CLEAR (For fire): Straight run siren for two minutes.

TEST: Straight run siren for two minutes.

3.8 EVACUATION

GUWAHATI REFINERY HOSPITAL

26 Beds hospital with Outdoor and Indoor facilities and 24 hours emergency coverage.

a)	No. of doctors	5 Nos. + 1 Officer (Admin)
b)	No. of consultants	10 Nos.
c)	No. of staff	30 Nos. + 34 casuals.

Investigation facilities:

- X-ray machine with IITV.
- U.S. G, TMT. And ECG
- Well Equipped Dental Unit & Opthalmology Unit
- Well equipped Pathological Laboratory
- Well equipped ICU and Operation Theatre
- Life saving medicines and equipments
- 24 hours Ambulance service.

We have also arrangement to accommodate about 100 patients in Govt. and nominated hospitals in the city as and when required.

3.8.1 ONSITE EVACUATION

Evacuation of non-essential personnel is an important part of emergency plan procedures. The objective is to move personnel away from the hazardous area to an assembly point near Emergency control centre where a head count can be carried out.

The following points should be followed:

- Direction signs to indicate evacuation routes in buildings and on elevated process structures.

- Wind socks for indication of wind direction is to be observed.
- Instruction to personnel that they should evacuate in a cross-wind direction, away from the vapour cloud if its extent is visible.
- Administration & Communication Coordinator / Fire Fighting & Rescue Coordinator shall announce on public address system for the assembly point in between gate no. 1 & gate no. 2 on the direction in which they should evacuate.
- CISF shall carry out a head count for contractor personnel and P&A shall carry out a head count for refinery employees.

3.8.2 OFF-SITE EVACUATION

If a major industrial accident does occur, the general public in surrounding areas will have very little time to react and save themselves. The local population will have to be warned in a very short period.

- Time available to population for a safe escape and threatened by the accident will depend on the nature of accident.
- A fire will give more time to escape and generally area affected will be small. Effects of a fire on population will be injuries due to thermal radiation.
- An explosion will give little time to warn population and area affected may be much larger than that in case of a fire. Effects of an explosion on the population will be injuries caused by shock wave, flying debris collapsing structures as well as exposure to thermal radiation.
- A toxic gas release will generally threaten a much larger area and people will be exposed to drifting cloud of toxic gas /vapours. Time available for warning population will depend on the point of release, air direction and air velocity.

3.8.3 ACTIONS BY GENERAL POPULATION

On being warned of a major industrial accident of gas leak general public should take the following actions:

- Immediately go indoors
- Shut all doors, windows, and ventilators. Block all the gaps with wet cloth and draw curtains.
- Switch off fans, exhaust fans, air conditioners.
- Extinguish all flames.
- Keep torches handy. Store water for emergency use.
- Do not jam emergency phone lines by calling emergency services.
- Covering nose / mouth with wet cloth will help.
- Wait for further instructions from emergency services before moving out.

3.8.4 EDUCATION

Educating general public about the potential hazards associated with refinery and actions to be taken in case of accident, will one of the key areas of disaster management plan. For this purpose, the following actions are proposed:

- Pamphlets / booklets regarding industrial hazards will be prepared and distributed to
  general public of the concerned area.
- Notice boards will be put up in strategic places giving the above information.

- Help of voluntary organisations and local schools will be taken to conduct educational sessions to make people aware of the actions that the general public should take in case of any major emergency.
- Periodic meetings with the village heads to educate them.

3.9 Assessing the situation at Site & declaration of emergency

Whosoever will notice any situation as per the scenarios, he will immediately inform to Fire Station Control Room / nearest Control Room by means of telephone or nearest alarm point or personally. Officer of Fire Station, after seeing the magnitude of the situation, will instruct Fire Station Control Room operator to blow Major Fire Siren. Accordingly a Wailing Siren for Two minutes will be blown by Fire Station Control Room operator and turnouts will be taken by Fire Fighting Crew alongwith officers of Fire & Safety Department to combat the situation.

If the turnouts taken by Fire Fighting crew are not capable of controlling the situation, after assessing the situation, the ED / GM of the refinery will declare the disaster. The information about declaring the disaster will be conveyed to Fire Station Control Room by any Officer of Fire & Safety Division.

- Fire Station Control Room operator will blow three wailing sirens of 2 minutes each with a time lag of 2 minutes between each siren to make the disaster known to the key personnel and employees of the refinery as well.

- The information about the disaster to key personnel will also be given on telephone by Fire Station Control Room operator and also by PA system.

3.9.1 IMPORTANT TELEPHONE NOS. AND ADDRESSES

SL. NO.	NAME/DESIGNATION (S/SHRI)	*ADDRESS*	TELEPHONE	
			OFFICE	RESIDENCE
1.	J BARPUJARI, GENERAL MANAGER	Qr. No. 1003 Sector-I, Township, Noonmati.	7101(Auto) 7103(Auto) 2657017(BSNL)	8101 (Auto) 8103 (Auto) 2657018(BSNL)
2.	N.K.SHARMA DY. GENERAL MANAGER, (MAT.).	Qr. No. 3008 Sector-III, Township, Noonmati.	7102 (Auto) 2657011(BSNL)	8102 (Auto) 26757012
3	G DASGUPTA DY GENERAL MANAGER (PN)	Qr.No.3104 Sector-III Township, Noonmati.	7104 (Auto) 2657043 (BSNL)	8104 (Auto) 2657044 (BSNL)
4	SK MITRA, DGM(P&U)	Qr. No. 3006 Sector-III Township, Noonmati.	7105(Auto) 2657015(BSNL)	8105 (Auto) 2657016(BSNL)

5	M.K. MITTAL, DGM(HSE)	Qr. No. 3007 Sector-III Township, Noonmati.	7106 (Auto) 2657025 (BSNL)	8106 (Auto) 2657026 (BSNL)
6	G K DEY, DGM (PN)- I/C	GH-20	7107 (Auto) 2657209 (BSNL)	8107 (Auto) 2657210 (BSNL)
7.	N K CHAKRABORTY, DGM (HR)	GH-4	7108 (Auto) 2657005 (BSNL)	8108 (Auto) 2657006 (BSNL)
8	S.P. BARUAH CPNM	Flat No. 1(A)5 Rodalee Apartments Hatigarh Chariali Zoo Narengi Road Guwahati – 781 024	7109(Auto) 2657009(BSNL)	9435137430
9	B.K.DAS CM (HSE)	Qr. No. 2400 Sector-II Township, Noonmati.	7302 (Auto) 2657007(BSNL)	8401 (Auto) 2657008(BSNL)
10	P.C. RAY CITM	Qr. No. 2404 Sector-II Township, Noonmati.	7651 (Auto) 2657021(BSNL)	8651 (Auto) 2657022(BSNL)
11	MAHESH KUMAR CFSM	Qr. No.3104 Sector-III, Township, Noonmati.	7501 (Auto) 2657069(BSNL)	8501(Auto) 2657069(BSNL)
12.	GK ARORA, CFM (I/C)	MH-13	7201 (Auto) 2657031 (BSNL)	8201 (Auto) 2657032 (BSNL)
13	Mrs.A.B. SARMAH CM(CC, CSR & TD)	Qr. No.3009 Sector-III, Township, Noonmati.	7141(Auto) 2657033(BSNL)	8141 (Auto) 2657261(BSNL)
SL. NO.	**NAME /DESIGNATION (S/SHRI)**	*ADDRESS*	**TELEPHONE**	
			OFFICE	**RESIDENCE**
13.	SK GOGOI CHRM	Qr. No. 1009 Sector-I Township, Noonmati.	7111 (Auto) 2657059(BSNL)	8111 (Auto) 2657059(BSNL)
14.	J BORGOHAIN CVM	MH-10	7113 (Auto) 2657027(BSNL)	8113 (Auto) 2657028(BSNL)

SL. NO.	NAME /DESIGNATION (S/SHRI)	*ADDRESS*	TELEPHONE	
			OFFICE	RESIDENCE
15	P.N.SHARMA CM(IS)	Qr. No.1027 Sector-I, Township, Noonmati	7115 (Auto) 2657260(BSNL)	8115 (Auto) 2657260 (BSNL)
16	P C MANDAL, CESM	Qtr. No.1034, Sector-I Township, Noonmati.	7801(Auto) 2657014(BSNL)	8801 (Auto) 2657063(BSNL)
17	S C YADAV, CMTM	Qr.No.3105, Sector-III Township, Noonmati.	7251(Auto) 2657055(BSNL)	8251 (Auto) 2657065(BSNL)
18	H L DAS, CTSM-I		7301(Auto) 2657072(BSNL)	
19	AND N K BARUAH, CTSM-II		7303(Auto) 2657042(BSNL)	
20	V.S.DESAI CIPM	Qr.No.3148 Sector-III, Township, Noonmati.	7111 (Auto) 2657059(BSNL)	8111 (Auto) 2657059(BSNL)
21	AP KUMAR, CMNMML	Qtr. No.1012, Sector-I, Township, Noonmati.	7113 (Auto) 2657027(BSNL)	8113 (Auto) 2657028(BSNL)
22	CK KACHARI, CPJM	City	7115 (Auto) 2657260(BSNL)	8115 (Auto) 2657260 (BSNL)
23	K K SARMA, CPUM	Qr.No.3005, Sector-III Township, Noonmati.	7701 (Auto) 2657134(BSNL)	8701 (Auto) 2657135 (BSNL)
24	Dr. A K SARMA, CMO	Qr. No.2001 Sector-II,Township, Noonmati	7531(Auto) 2657130(BSNL)	8531(Auto) 2657825(BSNL)
25	K CHANDRA, CM (SECURITY)	Qr.No.3004, Sector-III Township, Noonmati.	7112(Auto) 2657054(BSNL)	8112(Auto) 2657056(BSNL)
26	Ms.MANIKA DAS, CM (HSE)-II	MH-16	7346 2657013(BSNL)	

27	DC, CISF	Qtr. No.1007 Sector-I, Township, Noonmati.	7901 (Auto) 2657034(BSNL)	8901 (Auto) 2657035(BSNL)
28	NC Bora, RC, (MKTG)	CITY	7051 (Auto) 2550218(BSNL)	94350-43421(M)
29	P K MAZUMDER SMNMCL	CITY	7872 (Auto) 2657068(BSNL)	

Dy. General Manager (HR) will inform about the disaster to the following District Authorities

		Telephone Nos.	
		Office	***Residence***
i.	Deputy Commissioner , Kamrup (M)	2540149	2540104
ii.	Addl. Deputy Commissioner, Kamrup (M)		94351 83744 (M)
iii.	Sr. Superintended of Police, Kamrup (M)	2540278	2540105
iv.	Director fire services, Assam	2511329	2330435
v.	Dy. Director fire services, Assam	2270058	

3.9.2 Controlling the Situation

Inside the Plant

DGM (PN)-I/C, who is the Main Incident Controller, will take charge of the situation for the controlling disaster.

- DGM (PN) will direct the SPNM / PNM for plant shutdown, if so required.
- DGM (PN) will co-ordinate with CFSM about the important measures to be taken during fire fighting / rescue / evacuation.
- SPNM's, CFSM, PNM's, RSM's etc whose responsibilities have already been discussed earlier, will perform their duties in close co-ordination with DGM (PN).

Outside the Plant

DGM (HR) will co-ordinate with the District authorities for the following activities.

- Cordoning off the area, if required.
- Evacuation of nearby areas, if required.

3.9.3 External Public:

3.9.3.1 Public Awareness System

The safety measures to be taken in the event of an emergency shall be made known to

the general public who are likely to be affected.
For disclosure of information to the public the refinery they are briefed about our preparedness and measures taken to face any disaster situation. They are also explained about the Disaster Warning Signals and measures to be taken by the nearby villagers in case of any disaster in the refinery like toxic gas released and any possible chemical emergency. The same is being given to them in the form of a brief write up for further propagation in their villages.

or disclosure of the information, particularly during the disaster situation, the Public announcements are being done by GR Corporate Communication Department. To avoid any panic, it is been considered that the necessary announcement will be made in nearby villages releasing the information to the tune of requirement only.

For the purpose, use of Do's and don't's shall be prepared and furnished to the Crisis Mangament Group. Display boards carrying do's and don'ts should be located outside the gate as well as in the neighbouring colonies and other habitat areas in the immediate vicinity.

The Welfare & Media Co-ordinator of the refinery is the only authorised person for giving the informations to be public & to serve as the Laision Officer.

3.9.3.2 The use of Electronic Media

For bringing the awareness among the external public at large, the use of electronic media like TV, Air & Press coverage is used. The Welfare & Media co-ordinator of the refinery prepares the Press release to the issued for the local press & other important dailies.

3.10 LIST OF NAMES OF FUNCTIONARIES

List of name of various functionaries with designation and telephone numbers are given below for head office, regional office and pump stations.

3.10.1 Head Office/ Regional Office

Type of Coordinator	Name	Designation	Telephone Numbers	
			Office	Residential
Crisis Coordinator (HO)				
Crisis Coordinator (RO)				

3.10.2 Pump Station /Refinery

Type of	Name	Designation	Telephone Numbers			
Coordinator			Office		Residential	
			P&T	UHF	P&T	UHF
Chief Emergency (CEC)						
Fire & Safety						

Engineering						
Communication						
Medical						
Transport						
Security						
Materials						
Mainline Search party leader						

CHAPTER-4: EMERGENCY RESPONSE PROCEDURES

4.1 BACKGROUND

Since the Refinery having received crude, storing and distributing of HSD, MS, SKO, Ethanol, ATF and LPG. which are all inflammable in nature, due care is taken in its operation to avoid any mishap which may result in loss of material or loss of life. As such, emergency situation related to pumping operation or storing is a remote possibility.

The main emergencies associated with the storage of HSD, MS, SKO and Ethanol in tanks are as follows:

- Leakage of tanks due to steam or circumferential weld failure or attempted sabotage.
- Rupture/burst of tanks
- Leakage from valves

The above situations need immediate attention to avoid the following unwanted situations:

- Leakage of HSD, MS, SKO and Ethanol resulting in huge losses from tanks
- Spreading of the inflammable petroleum products in the vicinity
- Induction of fire hazards in the vicinity
- Pollution of river/canal water, cultivated fields and habitats
- Prolonged disruption in pumping operation.

The designated Primary Command Post where the Chief Coordinator assisted by other designated co-coordinators shall assemble on notification of emergency.
The Field Command Post is to be promptly established near the scene of accident. It shall be the nearest office/place having communication facilities to be manned continuously.

The response planning topics covered in this chapter are as follows:

- Initial Notification of Release
- Establishment and Staffing of Command Post
- Formulation of Response Objectives and Strategy at the incident site
- Ensuring Health and Safety at Incident Scenes
- Evacuation
- Fire Response

- Health Care
- Personal Protection
- Public Relations
- Spill Containment and Clean-up
- Documentation and Investigative Follow-up
- Training

In **Chapter 2**, the accident scenarios for planning response procedures and carrying out mock drill are suggested based on the risk analysis study.

However, it has to be appreciated that no two emergency scenarios are going to be alike since the escalation process depends upon a large number of variables including the response actions. It is therefore, not only impossible but also dangerous to lay down clear-cut responses applicable to all situations. For each emergency situation spot decisions will need to be taken often under high stress conditions.

4.2 INITIAL NOTIFICATION OF RELEASES

1. In case of emergency in Refinery

Any person noticing a fire, explosion or the release of hazardous materials should shout "LEAK" or "FIRE" and will break the glass of the nearest fire point. He will also inform the control room on the nearest telephone and the panel officer will inform SIC.

Action by Individual Employee at the time of emergency

When You Notice
FIRE
or
LEAKAGE

Please DO (√)

- Break the nearest fire alarm point glass.
- Immediately inform the control room.
- Act to control the incident as per the instructions.
- Reach the assembly point.

Please DO NOT (x)

- Get panicky or spread rumors.
- Approach control room without work.
- Engage telephone or loudophone continuously.

4.3 ESTABLISHMENT & STAFFING OF FIELD COMMAND POST

- Quickly establish a field command post near the scene of incident. The minimum that is necessary is a continuously manned communication system close to the incident site.
- It is the responsibility of the response personnel at the Field Command Post to restrict the entry or movement of people into the Hazard zone. The first step of a response action must be restriction of access to the spill site and other hazardous areas.
- Security and access control at Field Command Post and Primary Command Post need to be provided

4.4 FORMULATION OF RESPONSE OBJECTIVES AND STRATEGY AT THE INCIDENT SITE

- It is the responsibility of the CEC to decide on the appropriate response strategy specific to the situation prevailing. It is important to assess each particular incident before taking action.
- CEC in consultation with the Site Incident Controller will formulate realistic response objectives. The assessment should be based on resource requirement i.e., trained personnel and protective gear.

General

Upon completion of the incident assessment, command personnel will be in a better position to determine whether their response strategy should be defensive or offensive in nature. A defensive posture is best taken when intervention may not favorably affect the outcome of the incident, or is likely to place emergency response personnel in significant danger, and/or may possibly cause more harm than good. An offensive posture (i.e., one requiring response personnel to work well within the boundaries of hazard zones) is best taken when intervention is likely to result in a favorable outcome without exposing personnel to undue danger and without causing new and potentially more severe problems. In all cases, of course, actions to protect the public and environment outside the immediate spill or discharge area and/or to contain the hazard from a safe distance can be initiated regardless of whether a defensive or offensive response strategy is chosen at the actual incident site

4.5 ENSURING HEALTH AND SAFETY AT INCIDENT SCENES

The results of hazard analysis will be used to identify the vulnerable zone. Based on incident-specific factors, the exact size and configuration of hazard control zones will be determined. The Hazard Control Zones have been defined below.

The CEC will formulate safe operating procedures for a site safety and health program that addresses the following.

- The use of appropriate protective gear and equipment
- Limiting the number of personnel in the "Hot" and "Warm" hazard control zones.
- Utilizing the most experienced personnel for the most hazardous tasks.
- Positioning a backup team in the "Warm Zone" in case it is needed to assist or rescue personnel in the "Hot Zone".
- Providing medical surveillance for personnel before and after "Hot" and "Warm" Zone operations.
- Monitoring (visually and through communications contact) the welfare of personnel operating within the "Hot" and "Warm' Zones.
- Ensuring that all personnel understand their assignments.
- Ensuring that responders do not ingest contaminants through eating, drinking, or inhaling.
- Replacing fatigued personnel with "fresh" personnel.
- Adjusting hazard control zones to reflect changing conditions.

Hazard Control Zones

- "Hot Zone" - Area of maximum hazard surrounding the damaged container(s) or fire area, which may only be, entered by specially equipped and trained response personnel.
- "Warm Zone" - Area of moderate hazard outside the Hot Zone in which properly equipped and trained backup crews standby and decontamination takes place.
- "Cold Zone" - Area outside the Warm Zone that poses minimal or negligible hazards to emergency personnel. The primary Command post, most of the deployed apparatus, and the resource staging area should be located in the Cold Zone.

4.6 EVACUATION

- In case of an On-site emergency, the order to evacuate to a safe place will be given by the Chief Coordinator in consultation with other coordinators.
- In case of an Off-site emergency, the order to evacuate to a safe place will be given by the District Emergency Authority in consultation with Chief Coordinator in consultation with other coordinators.
- Accident scenarios covered in 'Risk Assessment study' can be a key source of information for evacuation planning where specific facilities are known to pose a threat. The size and shape of the vulnerable zone for selected scenarios are presented in Risk Assessment Report and have been summarized in Risk Assessment summary, Appendix B of this document.
- Evacuation and shelter-in-place decisions are incident specific and must be made at the time of an actual release. Guidance obtained from consequence

analysis may be considered a starting point for the decision process.

Some general guidelines in case of fire are:

Only Personnel in close vicinity and affected by heat radiation need be evacuated to safe distances. Non-essential personnel will usually be evacuated from the incident area and also from adjacent areas. Evacuation should be to a predetermined assembly point in a safe part of the complex. Assembly points marked on the plot plan should be appropriately displayed.

1. For serious injury cases, evacuation to hospital will be carried out by the response personnel.
2. Chief Coordinator should designate one individual to record all personnel arriving at the assembly point so that the information can be passed to the Primary Command Post.
3. At the Primary Command Post, a nominated person should collect the lists of personnel arriving at the assembly points with those involved in the incident. These should then be checked against the roll of those believed to be on-site, updated with known changes for that day. Where it is possible that missing people might have been in the area of emergency, the site incident controller should be informed and arrangements made to organize a further search.

4.7 FIRE RESPONSE

i. All available fire fighting resources will be mobilized in minimum time by head of fire fighting services at the time of emergency. The fire fighting arrangements including manpower and resources have been organized to deal with worst scenarios like the largest tank in Pump station on fire.
ii. Fire department need to be well prepared and experienced in rescuing people from fire and explosion situations.

General

Water is not suitable for extinguishing petroleum fires, though it may be used to keep surroundings cool and prevent the spread of fire to them. Adequate number of portable dry chemical or carbon dioxide extinguishers and foam concentrate need to be stocked. The quantity of foam requirement should be such as per OISD(117/118) guidelines.

4.8 HEALTH CARE

- Requisite medical resources will be mobilized under the overall charge of the Health and Medical functionary.
- The operational response will be coordinated from the control room.

4.9 PERSONAL PROTECTION

i. Specific skills need to be developed for the safe use of protective clothing through training and experience.

ii. The CEC will arrange for rapid availability of appropriate protective clothing in the event of an emergency.

4.10 PUBLIC RELATIONS

i. CEC will designate one specific individual as the Media Officer.

ii. The designated Media Officer only will speak to media personnel. The Media officer should ensure orderly and accurate dissemination of information. The "do's" and "don'ts" on how to deal with the media are discussed below.

- The CEC should understand the need to relay up-to-date "status reports" to the Media Officer on a regular basis.

THINGS TO DO:

- Accommodate the media as much as possible; make the news available to them.
- Schedule news conferences and preferably avoid written releases.
- Be direct and specific.
- Have news conferences immediately after any meeting from which the media or public have been barred.
- Send a press representative to the Primary control room.
- If safety permits, allow the media to take pictures of the accident site.

THINGS NOT TO DO

- Do not permit arguments among public officials or press officials from different organizations in front of the press. Do, however, permit statements of dissenting opinions.
- Avoid giving gut opinions or conjecturing.
- Do not be evasive. If the answer to a question is not known, refer the question to someone who has the appropriate answer.
- Do not be critical in a personal manner; i.e., avoid personal remarks about other people at the accident scene.
- Do not be philosophical. These kinds of discussions are extremely susceptible to being quoted out of context.
- Do not make off-the-record comments. They may end up in print with later retractions buried in the back pages.
- Avoid friendly chats with media people. Casual comments may appear in print.
- Avoid bad or foul language.
- Do not hide from the media. They can sense this and form an unfavorable opinion of the Media Officer as a credible source of news.

- Do not answer questions beyond personal knowledge or expertise.
- Do not permit media persons to attend emergency response team meetings.

4.11 SPILL CONTAINMENT AND CLEANUP

i. Trained personnel who are at ease in handling flammable liquids need to be mobilized. Plugging and stopping of leakage and containment of the spill should be attended to with great speed while taking all measures to prevent ignition.

ii. CEC will assign responsibility to one or more individuals for identifying methods of plugging or stopping leaks, assembling the materials and supplies necessary for this task and training for their use under emergency conditions. A minimum inventory of these items should be maintained at the pump station.

iii. Upon detection of hydrocarbon leakage/fire, the immediate actions to take are:
∗ Isolate the system
∗ Depressurize all affected equipments

iv. It is the responsibility of the CEC to identify the rapid availability of bulldozers or the earthmoving equipment capable of building dikes or digging trenches, properly equipped work crews with shovels or other equipment to build dikes or dig trenches, plastic sheeting or other compatible materials that can be used to line dikes, basins, or trenches used to collect liquids.

v. Plan for rapid sealing of drains and sewer openings to prevent entry of oil.

vi. Where necessary, plan for the rapid plugging of sections of storm drains to limit the spreading of Oil that have entered a drainage system.

vii. Where necessary, arrange for rapid availability of waterborne spill containment equipment and supplies such as spill containment booms, sorbent material, sand bags and other potentially necessary items.

viii. It is the responsibility of the CEC to identify the rapid availability of pumps, hoses, gulley suckers, temporary storage containers (or alternatively, vacuum trucks) to recover pools or other accumulations of hazardous liquids, properly equipped work crews with appropriate equipment, drums or other containers to hold contaminated solids, soil, or leaking packages, absorbent materials, sorbents, sand bags, earthmoving equipment, including dump trucks.

ix. As and if necessary, arrange for rapid availability of spill treatment and cleanup services.

4.12 DOCUMENTATION AND INVESTIGATIVE FOLLOW UP

i. CEC will assign responsibility to a functionary for real-time and post-incident documentation of the accident and resulting response actions.

ii. The responsible person will adopt appropriate reporting forms and procedures giving detailed records of what happened and what actions were taken in response.

General:

Detailed records of what happened and what actions were taken in response can help in:

- Attempting to recover response costs and damages from the party responsible for the incident.
- Setting the record straight where there are charges of negligence or mismanagement resulting from the incident.
- Reviewing the efficiency and effectiveness of response actions.
- Preparing for future incident responses.
- Verifying facts, actions, injuries, equipment used, etc. for the purpose of legal proceedings, insurance claims, budget requests, and public inquiries.

4.13 TRAINING

i. Training sessions need to be provided in which personnel are briefed on their specific duties in an emergency.

ii. To provide training to all emergency responders. The concerned personnel are shown how to wear and properly use personal protective clothing and devices.

iii. Periodic drills to be conducted to test the overall efficiency and effectiveness of the emergency response plan and emergency response capabilities.

General:

The types of training required for emergency response personnel with responsibilities in any or all phases of the response is based upon the types of incidents most likely to occur and the related response and planning activities. The selection of accident scenarios for emergency planning has been discussed in Appendix B.

4.14 Responsibility, Frequency and Procedure for Evaluation

The CEC is responsible for evaluating the effectiveness of the on-site emergency plan. Emergency mock drill should be conducted at an interval of six months. Experts should be invited to observe the mock drill in order to know their response and opinion. The recommendations following the discussions will help to identify the loopholes in the plan and response capability of the organization. Such periodic recommendations of the mock drill should be kept in order to update the plan.

The CEC should be responsible to update their on-site emergency plan regularly. A regular review of the plan at least once in a year should be carried out to replace outdated information or to incorporate the results of mock drill.

CHAPTER-5: OFF-SITE EMERGENCY RESPONSE

5.1 INTRODUCTION AND DEFINITION OF OFF-SITE EMERGENCY

An emergency, which is likely to develop or has developed such as to pose a threat to members of the public out side the facility boundary, is termed as an *Off-site emergency*.

This distinction needs to be clearly appreciated. Whereas the responsibility for handling an On-site emergency is clearly that of the operating company, the responsibility for an Off-site emergency response lies with the civic authorities. Off-site emergency response needs actions by various Government agencies over which the operating company has no control.

This Chapter briefly describes the organizational aspects, duties and responsibilities of various civic authorities for an Off-site emergency response. The objective is to familiarize personnel with off-site emergency organization, and their legal responsibility to enable IOCL personnel to dovetail their efforts in an effective and orderly fashion while assisting the civic authorities.

5.2 LEGAL AUTHORITY AND RESPONSIBILITY FOR OFF-SITE EMERGENCY RESPONSE LEGISLATION IN INDIA

Under the Environment (Protection) Act, 1986 the 'Manufacture, Storage and Import of Hazardous Chemicals Rules' were promulgated in November, 1989 and 'Rules on Emergency Planning, Preparedness and Response for Chemical Accidents' in 1996.

Under the 'Manufacture, Storage and Import of Hazardous Chemicals Rules' preparation of 'Off-site Emergency Plan' is covered in Rule No.14. The duty of preparing and keeping up to date the 'Off-site Emergency Plan' as per this rule is placed on the District Emergency Authority (DEA). Also, occupiers are charged with the responsibility of providing the above authority with such information, relating to the industrial activity under their control, as they may require for preparing the off-site emergency plan.

Under the 'Rules on Emergency Planning, Preparedness and Response for Chemical Accidents' as gazetted in notification dated 1st August 1996 Central Crisis Group (CCG), State Crisis Group (SCG), District Crisis Group (DCG) and Local Crisis Group (LCG) need to be constituted for management of chemical accidents. The Ministry of Environment and Forests is the nodal Ministry for management of chemical disasters in the country. In order to respond adequately during a major chemical emergency, a coordinated effort at local, District, State and Central levels is needed and all available resources need be mobilized to deal with the crisis in the shortest possible time with least adverse effects. The Joint Secretary in the MoEF responsible for Hazardous Substance Management is the Member Secretary of the CCG. The Group functions under the chairmanship of Union Secretary (Environment & Forests). Similarly, a SCG and the DCG has to be constituted in every State and at district levels. The LCG will be the body in the industrial pocket to deal with chemical accidents and co-ordinate efforts in planning, preparedness and mitigation of a chemical accident. The Major Accident Hazard (MAH) installations in the industrial pockets will aid, assist and facilitate functioning of the LCG. As per the rules, the functions of the LCG are detailed below:

- Prepare local emergency plan for the industrial pocket.
- Ensure dovetailing of the local emergency plan with the district off-site emergency plan.
- Train personnel involved, in chemical accident management.
- Educate the population, likely to be affected in a chemical accident, about the remedies and existing preparedness in the area.
- Conduct at least one full-scale mock drill every six months and forward a report to the DCG.
- Respond to all public inquiries on the subject.

Similarly, the DCG, SCG and the CCG will provide expert guidance for handling major chemical accidents. The DCG and the SCG will assist the district administration and the State Government administration in the management of chemical accidents. The CCG, the apex body in the Centre will render all financial and infrastructure help as may be necessary in a state in case of an accident.

5.3 OFF-SITE EMERGENCY PLAN OBJECTIVES

The overall goal is to prevent loss of life or damage to health, promote social well being, avoid property damage, and ensure environmental safety around MAH units in the Industrial area during emergency. Its specific objectives are:

- To establish emergency response plan in the local area
- To provide information to the concerned members of the local area e.g. LCG members on the hazards involved in industrial operations in its neighborhood and the measures taken to reduce these risks.
- Increase industry involvement in emergency response planning.
- Involve LCG members in the development, testing and implementation of the overall emergency response plan.

Emergencies could arise due to different types of chemical accidents and it is not practicable to develop complete detailed response procedures for every conceivable type of emergency situation. However, advance planning can create a high order of preparedness to limit and minimize the adverse effects of an emergency caused by a chemical accident. Emergency plans are not static documents and need to be updated from lessons learnt during drills, experiences and other sources. A good communication system, training and understanding of emergency procedures, regular interaction between Government agencies and industries, education of the public and high degree of availability of emergency equipment are the key areas for effective off-site emergency preparedness.

5.4 IMPORTANT GOVERNMENT AGENCIES INVOLVED IN OFF-SITE EMERGENCY ACTIONS

In the implementation of the Off-site Emergency Plan, the district collector is designated as the DEA.

The following members of the crisis group will also invariably assist DEA:

• Police	Warning and Advice to the Public-Security measures; Rescue & Evacuation
• Head of Fire Services	Help the industry concerned in fire fighting operations and rescue
• Medical Officer	Treatment of affected persons
• Head of Civil Defense	Rescue and Evacuation operations
• Head of Electricity Board	Ensuring uninterrupted power supply or de-energize power supply as required

5.5 RESPONSIBILITY OF DEA

In case of an offsite emergency, the On-Site Chief Emergency Coordinator located at respective pump station will report the matter to the DEA or as specified in the Off-site emergency plan. The DEA will initiate the action plan to combat the emergency. The various responsibilities are:

- Take overall responsibility for combating the offsite emergency.
- Direct the police and fire personnel to combat the emergency.
- Arrange, if necessary, for warning and evacuating of the public, by the Department of Police.
- Direct the team of Doctors headed by the Medical Officer
- Direct the Chief of Transport Corporation to arrange for transportation of victims and evacuation of people trapped within the hazard zone.
- Direct the Electricity Board official to give uninterrupted power supply.
- Direct the official in-charge to provide uninterrupted water supply as required.
- Direct the Revenue Officer and the Supply officer to provide safe shelters, food and other life sustaining requirements for the evacuees if required.
- Nominate a press officer

5.6 RESPONSIBILITY OF CRISIS GROUP

The responsibilities of the members of the crisis group are:

- To develop an integrated response strategy based on the available information.
- To plan deployment of field units to ensure the availability of appropriate force to deal with the situation.
- To co-ordinate the functioning of the various agencies.
- To deal with crisis.
- To monitor the progress till the crisis ends.

5.7 LIST OF TELEPHONE NUMBERS OF OUTSIDE AGENCIES AROUND THE REFINERY

5.7.1 District Collectors

SN	FUNCTIONARIES	CONTACT DETAILS		
		OFFICE	RESIDENCE	CELL NO
A	**DISTRICT ADMINISTRATION**			
1	Dy Commissioner, Kamrup (M)	2540149	2540104	94350 49546
2	Addl.Dy Commissioner (Disaster Mgmt), Kamrup (M)	2547134	-	94351 83744
3	Emergency control Room DC office	2733052	-	-
B	**Police Services**			
4	SSP (City)	2540278		94353 51112
7	SP (Traffic)	2731847	-	9435025425
8	DSP (Traffic)	-	-	9435105167
C	**CIVIL DEFENSE**			
10	Dy.Controller Civil Defense	2305830	-	9435016446
D	**FIRE SERVICES**			
12	Director Fire Services , Assam	2511329	2330435	9435041100
13	Dy.Director Fire Services, Panbazar	2270058	-	94350 22604
E	**HEALTH SERVICES**			
17	Director Health Services, Assam	2261630	-	96780 98099
18	Jt .Director Health Services, Assam	2543818	-	94351 97486
F	**NF RAILWAYS**			
19	Chief Operations Mangager, NF Raiways	2676006	2676007	99575 50900
G	**POLLUTION CONTROL BOARD OF ASSAM**			
21	Member Secretary,PCBA	2550258		9435271696 / 8811013003
H	**DEPTT.OF INSPECTORATE OF FACTORIES**			
22	Chief Inspector of Factories, Assam	2528204	-	94351 06695
23	Sr. Inspector of Factories, Assam	2462159		9435102132
I	**PETROLEUM & EXPLOSIVE SAFETY ORGANIZATION (PESO)**			
24	Dy. Controller of Explosives , Assam			9830058036
J	**DEPTT OF BOILERS INSTECTORATE**			
25	Chief Inspector of Boilers, Assam			99544 82923
26	Inspector of boilers, Assam			94350 25713
K	**MoEF,SHILLONG**			
27	Dr. S.C.Katiyar, Joint Director (s)	-	-	94361 00802

5.7.2 Fire Stations around Refinery

Guwahati fire station is found out side the refinery.

5.7.3 Hospitals around Refinery

5.7.3.1 CONTACT NUMBERS AND ADDRESS OF POSSIBLE LOCAL ASSISTANCE INCLUDING MEDICAL FACILITIES

5.7.3.2 LIST OF HOSPITALS WITH TELEPHONE NUMBERS:

i. Guwahati Medical College Hospital 2529457/ 2460014
ii. MMC Hospital, Panbazar 2541477/2543998
iii. East End Nursing Home, Bamunimaidan 2550334
iv. Down Town Hospital Ltd., GS Road, Dispur 2331003/2331824/2336911
v. Guwahati Neurological Research Centre, Dispur 2227700 to 2227704
vi. Barthakur Clinic Pvt. Ltd, Kharguli 2546233/2543411/2730982
vii. Dispur Polyclinic, Dispur 2260864/2220769/2262652
viii. Care Home & Diagnostic, Bamunimaidan 2550202.
ix. International Hospital 2347700/2347701-3/2347715
x. B.B. Cancer Institute 2472366/2472636/2472364
xi. SankardevNethralaya 2228921/2228879/2228880/2305516

5.7.3.3 TELEPHONE NUMBERS OF SPECIALISTS / OUTSIDE DOCTORS

SL.NO	NAME	SPECIALISATION	PHONE NO.
1	Dr. Ashif Ahmed	Dentist	98640-97338
2	Dr. T. C Hazarika	Child	94350-40796
3	Dr. R J. Das	ENT	98640-93902
4	Dr. N J. Borkotoki	Neurologist	9435116404
5	Dhanjit Sarma	Physiotherapist	98540-44344
6	Dr. R Sinha	Homeopathy	94351-92052
7	Dr. D K barman		98640-93970
8	Dr. M. Goswami	Consultant surgeon	9435193724
9	Dr. Nilakshi Baruah	Eye	8822095391
10	Dr. Rani Manjula Das	Pathologist	9085835993

5.7.3.4 ADDRESS AND THE TELEPHONE NUMBERS OF MEDICAL SHOPS IN GUWAHATI CITY

i) M/s Maa Durga Pharmacy, Ph. No 2558861
P.O. Noonmati, Guwahati – 20

ii)	M/s Labanya Medicos, P.O. Noonmati, Guwahati –20	Ph. No 2550765
iii)	M/s Bharati Pharmacy P.O. Noonmati, Guwahati –20	Ph. No 2552945
iv)	M/s. Binada Medical, P.O. Noonmati, Guwahati –20	Ph. No. 2652436
v)	M/s. Dulung Medicos, P.O. Noonmati, Guwahati –20	Ph. No. 2652893
vi)	M/s. Great Upasana Medicos, P.O. Noonmati, Guwahati –20	Ph. No. 2656465
vii)	M/s. Ideal Pharmacy, P.O. Uzanbazar, Guwahati – 3	Ph. No. 2511951
viii)	M/s. Medicure, P.O. Chandmari, Guwahati – 3	Ph. No. 2667869
ix)	M/s. Anee Pharmacy, P.O. Bharalumukh, Guwahati – 1	Ph. No. 2600311
x)	M/s. Helpline Drugs, P.O. Chandmari, Guwahati – 3	Ph. No. 2662417
xi)	M/s. S. S. Medicos, P.O. Chandmari, Guwahati – 3	Ph. No. 2662892

5.8 ADDRESS AND THE TELEPHONE NUMBERS OF 24 HRS MEDICAL SHOPS IN GUWAHATI CITY

i)	Purbanchal Drugs (Bhangagarh)	2529774
ii)	Down-Town Hospital Pharmacy	2330659/ 95
iii)	Lachit Drugs (Bhangagarh)	2451062
iv)	New-Vishal Medicos (Rajgarh)	2456096
v)	New Amrit Medicals (Lachit Nagar)	2459078
vi)	Help Line Drugs (Chandmari)	2662417, 98640-42155
vii)	New Chakreswar Medical (Maligaon)	2673088
viii)	Neeshant Medicals (Down Town)	2332218, 1620167

5.9 ADDRESS AND THE TELEPHONE NUMBERS OF BLOOD BANK

i)	Guwahati Medical College Hospital	2529457, 2528417
ii)	Assam Gujrat Voluntary Blood Bank and Research Centre	2524939
iii)	Maruwari Yuva Manch	2516798, 2542074, 2547251

iv)	Ganga Lab & Blood Bank	2456616

5.10 ADDRESS AND THE TELEPHONE NUMBERS OF OXYGEN CYLINDER

i)	Rajyamalla Deka Welfare Society Free Oxygen Service	2664211, 2662851
ii)	Brahmaputra Oxygen Ltd. Athgaon	2510610
iii)	Marwari Yuva Manch	2516798, 2542074
v)	Lions Club	2522390 (City), 2516138(Central)

5.11 ADDRESS AND THE TELEPHONE NUMBERS OF AMBULANCE SERVICE

i)	Lions Club	2204577, 2544235, 2544155, 2545611, 2555155
ii)	Indian Red Cross	2665114
iii)	Prof.Uday Dutta Memorial Ambulance Service	98640- 27534, 27535
iv)	Maruwari Yuva Manch	2542074, 2547251
v)	Guwahati Medical College	2529457
i)	GNRC	9864010000
ii)	GUMTA	2512068, 2511470

5.12 ADDRESS AND THE TELEPHONE NUMBERS OF DEAD BODY CARRYING VAN SERVICE

i)	G.L.P.Social Circle	2737373, 9435047046
ii)	Maruwari Yuva Manch	2542074, 2547251
iii)	Athgaon Kabarsthan	2516096
iv)	Gangotri (Noonmati)	9864269839

ANNEXURE-IX:
MOEF EMISSION AND DISCHARGE LIMITS

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 18th March, 2008

G.S.R. 186(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) Amendment Rules, 2008.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986,-

(i) in Schedule –I, -

(a) for serial number 3, relating to 'OIL REFINERY INDUSTRY' and entries relating thereto, the following serial number and entries shall be substituted, namely:-

S. No.	Industry	Parameter	Standard
1	2	3	4
"3	Petroleum Oil Refinery	A. Effluent	
			Limiting value for concentration (mg/l except for pH)
		1. pH	6.0 –8.5
		2. Oil & Grease	5.0
		3. $BOD_{3 days, 27°C}$	15.0
		4. COD	125.0
		5. Suspended Solids	20.0
		6. Phenols	0.35
		7. Sulphides	0.5
		8. CN	0.20
		9. Ammonia as N	15.0
		10. TKN	40.0
		11. P	3.0
		12. Cr (Hexavalent)	0.1
		13. Cr (Total)	2.0
		14. Pb	0.1
		15. Hg	0.01
		16. Zn	5.0
		17. Ni	1.0
		18. Cu	1.0
		19. V	0.2
		20. Benzene	0.1
		21. Benzo (a) – Pyrene	0.2
		Notes.- (i) Concentration limits shall be complied with at the outlet, discharging effluent (excluding discharge from sea water cooling systems) to receiving environment (surface water	

1	2	3	4
		Bodies, marine systems or public sewers). In case of application of treated effluent directly for irrigation/horticulture purposes (within or outside the premises of refinery), make-up water for cooling systems, fire fighting, etc., the concentration limits shall also be complied with at the outlet before taking the effluent for such application. However, any use in the process such as use of sour water in desalter is excluded for the purpose of compliance. (ii) In case of circulating seawater cooling, the blow-down from cooling systems shall be monitored for pH and oil & grease (also hexavalent & total chromium, if chromate treatment is given to cooling water) and shall conform to the concentration limits for these parameters. In case of reuse of treated effluent as cooling water make-up, all the parameters (as applicable for treated effluent) shall be monitored and conform to the prescribed standards. (iii) In case of once through cooling with seawater, the oil & grease content in the effluent from cooling water shall not exceed 1.0 mg/l.	

B. Emissions

			Limiting concentration in mg/Nm³, unless stated		
			Fuel Type	**Existing refineries**	**New Refinery/Furnace/ Boiler**
	(Furnace, Boiler and captive Power Plant)	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	5
			Liquid	100	50
		Carbon Monoxide (CO)	Gas	150	100
			Liquid	200	150
		Nickel and Vanadium (Ni+V)	Liquid	5	5
		Hydrogen Sulphide (H_2S) in fuel gas	Liquid / gas	150	150
		Sulphur content in liquid fuel, weight %	Liquid/ gas	1.0	0.5

Notes.-

(i) In case of mixed fuel (gas and liquid) use, the limit shall be computed based on heat supplied by gas and liquid fuels.

(ii) 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 or boilers shall be carried out once in two months.

(iii) All the emission parameters in furnaces/boilers having heat

1	2	3	4
			input less than 10 million kilo calories/hour will be monitored once in three months.
		(iv)	In case of continuous monitoring, one hourly average concentration values shall be complied with 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.
		(v)	Data on Nickel and Vanadium content in the liquid fuel (in ppm) shall be reported. Nickel and Vanadium in the liquid fuel shall be monitored at least once in six months, if liquid fuel source & quality are not changed. In case of changes, measurement is necessary after every change.

	(FCC Regenerators)		**Limiting concentration in mg/Nm³, unless stated**		
			Existing refineries		**New Refinery /FCC Commissioned**
			hydro processed FCC feed	Other than Hydro processed FCC feed	
		Sulphur Dioxide (SO_2)	500	1700	500 (for hydro-processed feed) 850 (for other feed)
		Oxides of Nitrogen (NO_x)	400	450	350
		Particulate Matter (PM)	100	100	50
		Carbon Monoxide (CO)	400	400	300
		Nickel and Vanadium (Ni+V)	2	5	2
		Opacity, %	30	30	30
		Notes: (i) In case part feed is hydro-processed, the emission values shall be calculated proportional to the feed rates of untreated and treated feeds. (ii) FCC regenerators shall have continuous systems for monitoring of SO_2 and NO_x. One hourly average concentration values shall be complied with 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.			

1	2	3	4
		(iii) Any concentration value obtained through manual monitoring, if exceeds the limiting concentration value, shall be considered as non-compliance. (iv) Data on Sulphur (weight in %), Nickel (PPM) and Vanadium (PPM) content in the feed to FCC shall be reported regularly. (V) Limit of Carbon Monoxide emissions shall be complied with except during annual shut down of CO boiler for statutory maintenance.	

			Plant capacity (Tonnes/day)	Existing SRU	New SRU or Refinery Commissioned
	[Sulphur Recovery Units (SRU)]	Sulphur recovery, %	Above 20	98.7	99.5
		H_2S, mg/Nm³		15	10
		Sulphur recovery, %	5-20	96	98
		Sulphur recovery, %	1-5	94	96
		Oxides of Nitrogen (NO_x), mg/Nm³	All capacity	350	250
		Carbon Monoxide (CO), mg/Nm³	All capacity	150	100
		Notes: (i) Sulphur recovery units having capacity above 20 tonnes per day shall have continuous systems for monitoring of SO_2. Manual monitoring for all the emission parameters shall be carried out once in a month. (ii) Data on Sulphur Dioxide emissions (mg/Nm³) shall be reported regularly. (iii) Sulphur recovery efficiency shall be calculated on monthly basis, using quantity of sulphur in the feed to SRU and quantity of sulphur recovered.			

C - Fugitive Emission

Storage of Volatile Liquids : General Petroleum Products

(1) Storage tanks with capacity between 4 to 75m³ and total vapour Pressure (TVP) of more than 10 kpa should have Fixed Roof Tank (FRT) with pressure valve vent.

(2) Storage tanks with the capacity between 75 to 500 m³ and total vapour Pressure (TVP) of 10 to 76 kpa should have Internal Floating Roof Tank (IFRT) or External Floating Roof Tank (EFRT) or Fixed Roof Tank with vapour control or vapour balancing system.

(3) Storage tanks with the capacity of more than 500 m³ and total vapour Pressure (TVP) of 10 to 76 kpa should have Internal Floating Roof Tank or External Floating Roof Tank or Fixed Roof Tank with vapour control system.

(4) The tanks with the capacity of more than 75 m³ and total vapour Pressure (TVP) of more than 76 kpa should have Fixed Roof Tank with vapour control system.

(5) Requirement for seals in Floating Roof Tanks:

(i) (a) IFRT and EFRT shall be provided with 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 cm²/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 cm²/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) Inspection and maintenance of storage tanks shall 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 shall be examined.

Storage of Volatile Liquids : Benzene Storage

(1) FRT with vapour to incineration with 99.9% of removal efficiency for volatile organic compounds (VOC) shall be provided.

(2) 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.

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% shall be provided.

[Emission control for Road tank truck/ Rail tank wagon loading			
	Loading of Volatile Products	Gasoline and Naphtha: (i) VOC reduction, % (ii) Emission, gm/m³	(i) 99.5 ii) 5
		Benzene: (i) VOC reduction, % (ii) Emission, mg/m³	(i) 99.99 (ii) 20
		Toluene/Xylene: (i) VOC reduction, % (ii) Emission, mg/m³	(i) 99.98 (ii) 150
		Note: (i) It shall be applicable for Gasoline, Naphtha, Benzene, Toluene and Xylene loading. (ii) Road tank Truck shall have Bottom loading and Rail tank wagon shall have Top submerged loading. (iii) Annual leak testing for vapour collection shall be done.	

Standards for 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 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 inch 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°C > 1.0 kPa; and (iii) Heavy liquid with vapour pressure @ 20°C 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) Definition of leak: 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 to:

Component	General Hydrocarbon (ppm)		Benzene (ppm)	
	Till 31st Dec. 2008	w.e.f. January 01, 2009	Till 31st Dec. 2008	w.e.f. January 01, 2009
Pump/Compressor	10000	5000	3000	2000
Valves/Flanges	10000	3000	2000	1000
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
	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 percentage 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 and 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 vapour 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.

D. Emission Standards for VOC from Wastewater Collection and Treatment

(1) All contaminated and odorous wastewater streams shall be handled in closed systems from the source to the primary treatment stages (oil-water separator and equalization tanks).

(2) The collection system shall be covered with water seals (traps) on sewers and drains and gas tight covers on junction boxes.

(3) Oil-water separators and equalization tanks shall be provided with floating/fixed covers. The off-gas generated shall be treated to remove at least 90% of VOC and eliminate odour. The system design shall 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 shall be designed and operated for safe maintenance of the collection and primary treatment systems.

(4) Wastewater from aromatics plants (benzene and xylene plants) shall be treated to remove benzene & total aromatics to a level of 10, 20 ppm respectively before discharge to effluent treatment system without dilution."

(b) Serial number 35, relating to 'oil refineries (sulphur oxide) and entries relating thereto shall be omitted;

(ii) in Schedule VI, in Part C, -

(a) serial number 1 relating to 'Oil Refinery Industry' and entries relating thereto, the following serial number and entries shall be substituted, namely :-

"**1. Petroleum Oil Refinery :**

Parameter 1	Standard 2
	Quantum limit in Kg/ 1,000 tonne of crude processed
1. Oil & Grease	2.0
2. $BOD_{3\ days,\ 27^{o}C}$	6.0
3. COD	50
4. Suspended Solids	8.0
5. Phenols	0.14
6. Sulphides	0.2
7. CN	0.08
8. Ammonia as N	6.0
9. TKN	16
10. P	1.2
11. Cr (Hexavalent)	0.04
12. Cr (Total)	0.8
13. Pb	0.04

Parameter 1	Standard 2
	Quantum limit in Kg/ 1,000 tonne of crude processed
14. Hg	0.004
15. Zn	2.0
16. Ni	0.4
17. Cu	0.4
18. V	0.8
19. Benzene	0.04
20. Benzo (a) – Pyrene	0.08

Notes :

(i) Quantum limits shall be applicable for discharge of total effluent (process effluent, cooling water blow down including sea cooling water blow down, washings, etc.) to receiving environment (excluding direct application on land for irrigation/horticulture purposes within the premises of refinery).

(ii) In order to measure the quantity of effluent (separately for discharge to receiving environment, application for irrigation/horticulture purposes within the premises of refinery & blow-down of cooling systems), appropriate flow measuring devices (e.g. V-notch, flow meters) shall be provided with.

(iii) Quantum of pollutants shall be calculated on the basis of daily average of concentration values (one 24-hourly composite sample or average of three grab samples, as the case may be), average flow of effluent during the day and crude throughput capacity of the refinery.

(iv) Limit for quantity of effluent discharged (excluding blow-down from seawater cooling) shall be 400 m^3/1000 tonne of crude processed. However, for refineries located in high rain fall area, limit of quantity of effluent only during rainy days shall be 700 m^3/1000 tonne of crude processed.".

[F. No. Q-15017/15/2007-CPW]

R. K. VAISH, 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 S.O. 433 (E) dated 18th April, 1987, S.O. 64 (E) dated 18th January, 1988, S.O. 3 (E) dated 3rd January, 1989, S.O. 190 (E) dated 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 5th 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 and G.S.R. 849 (E) dated the 30th December, 2002, G.S.R. 520 (E) dated 1st July, 2003, G.S.R. 92 (E) dated 29th January, 2004, G.S.R. 448 (E) dated 12th July, 2004, Corrigenda G.S.R. 520 (E) dated 12th August, 2004, G.S.R. 272 (E) dated 5th May, 2005, G.S.R. 315 (E) dated 16th May, 2005, G.S.R. 546 (E) dated 30th August, 2005, G.S.R. 46 (E) dated 3rd February, 2006, G.S.R. 464 (E) dated 7th August, 2006 , G.S.R. 566 (E) dated 29th August, 2007 and G.S.R. 704 (E) dated 12th November, 2007.

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ANNEXURE-X:

BASELINE DATA OF AIR, WATER AND SOIL FOR LAST ONE YEAR (2012-13)

Baseline data of Soil Samples in the study area for the year of 2012-13 (Source: EIA report of Proposed INDAdept[G;] IOCL Guwahati)

Table 1: Locations for Soil Samples (2012-13)

S/N	Identity	Sampling Locations	Source
1	S1	Gauhati University (Jalukbari)	University Playground
2	S2	Maligaon	Field (Station Colony)
3	S3	Kamakhya	Residential
4	S4	Sukleshwar	Residential
5	S5	Kachari	Field
6	S6	Tatimara (Chandrapur)	Field
7	S7	Hajobari	Paddy Field
8	S8	Panikhaiti (Panikhaiti L.P School)	School Ground
9	S9	Kalitakuchi (Birkuchi)	Field
10	S10	Gariagaon(Jalah Puspabhadra Girl's School)	School Ground
11	S11	Rangmahal	Paddy Field
12	S12	Fulung (Dirgheshwary High School)	School Ground
13	S13	Suktaguri	Field
14	S14	Upper Kurua	Residential
15	S15	Lenga Gaon	Residential
16	S16	Jorabat	Roadside
17	S17	Khanapara	Play Ground
18	S18	Rukminigaon	Residential
19	S19	Japorigog (Ganeshguri)	Field
20	S20	Kharghuli	Residential
21	S21	Noonmati (near KV Noonmati)	Field

Table 2: Results of Analysis of the Soil Samples during (2012-13)

S/N	Parameter	Soil samples						
	Physical	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
1	pH (1: 20 suspension)	7.56	7.73	7.57	8.49	7.84	7.50	7.94
2	Conductance (mS/cm)	0.12	0.18	0.56	0.52	0.50	0.28	0.27
	Soil Texture (up to 60 cm)							
3	Sand (%)	83.5	83.5	86.0	87.0	80.0	82.5	76.9
4	Silt (%)	1.5	1.0	1.4	1.5	1.5	1.0	1.5
5	Clay (%)	15.0	15.5	12.5	11.5	18.5	16.5	21.6
6	Water Holding Capacity (%)	48.4	52.2	51.9	47.6	31.2	34.3	41.5
7	Bulk Density (g cm^{-3})	0.46	0.42	0.43	0.44	0.42	0.38	0.42
8	Hydraulic Conductivity (cm/min)	0.28	0.34	0.16	0.37	0.18	0.24	0.18
	Chemical							
9	Nitrogen (%)	0.08	0.14	0.13	0.04	0.06	0.04	0.08
10	Potassium (mg/kg)	2.9	2.1	4.3	2.1	2.0	2.5	6.1
11	Sodium (mg/kg)	3.3	3.0	6.1	6.7	2.9	3.7	3.1
12	Calcium (mg/kg)	1275	981	1078	809	577.2	866	70
13	Magnesium (mg/kg)	259	429	387	159	117.0	59	11.7
14	Phosphorous (mg/kg)	0.85	0.26	0.57	0.22	0.31	0.45	0.29
15	Sulphate(mg/kg)	20.0	35.0	26.8	23.3	27.1	37.3	36.3
16	Chloride (mg/kg)	14.2	17.8	16.7	16.0	21.2	14.2	12.4
17	Organic matter (%)	0.23	0.34	0.98	1.24	0.41	1.34	0.39
18	Oil and Grease (mg/kg)	1.9	2.1	3.2	2.1	0.7	4.1	1.8
	Heavy Metals							
19	Iron (g/kg)	109.9	144.9	101.4	97.9	141.3	113.5	105.4
20	Manganese (g/kg)	3.02	3.21	1.70	1.97	3.27	3.84	2.71
21	Zinc (mg/kg)	BDL	BDL	BDL	BDL	0.02	0.08	BDL
22	Lead (mg/kg)	0.23	BDL	0.20	BDL	0.23	0.16	0.28
23	Chromium (mg/kg)	0.13	0.49	0.14	0.00	0.44	0.34	0.34
24	Copper (mg/kg)	0.29	0.31	0.15	0.25	1.57	0.33	0.29
25	Cobalt (mg/kg)	0.18	0.21	0.17	0.24	0.09	0.07	0.19
26	Cadmium (mg/kg)	0.01	0.08	0.70	0.01	0.06	0.30	0.07

Table 3: Results of Analysis of the Soil Samples during (2012-13)

S/N	Parameter	Soil samples						
	Physical	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**	**S14**
1	pH (1: 20 suspension)	7.28	6.98	6.34	7.15	7.23	7.09	7.22
2	Conductance (mS/cm)	0.51	0.15	0.10	0.02	0.11	0.06	0.01
	Soil Texture (up to 60 cm)							
3	Sand (%)	70.0	77.7	77.2	81.9	76.8	77.1	76.6
4	Silt (%)	3.6	2.2	1.5	0.6	2.5	2.7	3.1
5	Clay (%)	26.4	20.1	21.3	17.5	20.7	20.2	20.2
6	Water Holding Capacity (%)	32.7	48.1	44.5	52.1	32.4	51.6	52.0
7	Bulk Density (g cm^{-3})	0.37	0.46	0.41	0.40	0.43	0.39	0.37
8	Hydraulic Conductivity (cm/min)	0.23	0.25	0.31	0.19	0.28	0.142	0.32
	Chemical							
9	Nitrogen (%)	0.16	0.13	0.04	0.16	0.14	0.17	0.23
10	Potassium (mg/kg)	4.1	7.2	3.9	5.1	2.8	4.6	3.1
11	Sodium (mg/kg)	4.7	3.9	2.9	3.2	3.3	3.6	2.4
12	Calcium (mg/kg)	48.3	86.6	196.2	82.8	68.5	45.8	37.7
13	Magnesium (mg/kg)	13.6	78.0	39.0	97.5	78.0	136.4	78.0
14	Phosphorous (mg/kg)	0.52	0.41	0.14	0.46	0.41	0.62	0.18
15	Sulphate(mg/kg)	23.1	12.0	15.9	20.7	14.5	27.0	43.0
16	Chloride (mg/kg)	58.6	16.2	10.6	8.9	13.9	14.2	10.7
17	Organic matter (%)	1.36	0.42	0.44	0.61	0.61	0.47	1.34
18	Oil and Grease (mg/kg)	0.9	6.2	5.6	2.5	2.1	4.1	6.5
	Heavy Metals							
19	Iron (g/kg)	137	94	106	153	113	134	164
20	Manganese (g/kg)	3.2	2.9	1.4	3.4	1.8	3.7	3.7
21	Zinc (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Lead (mg/kg)	0.43	BDL	O.24	0.08	0.17	0.37	0.31
23	Chromium (mg/kg)	0.56	BDL	0.16	0.46	0.26	0.50	0.60
24	Copper (mg/kg)	0.43	0.18	0.33	0.35	0.20	0.44	0.49
25	Cobalt (mg/kg)	0.13	BDL	0.14	0.16	0.08	0.23	0.09
26	Cadmium (mg/kg)	0.07	0.07	0.11	0.04	0.08	0.03	0.03

Table 4: Results of Analysis of the Soil Samples during (2012-13)

S/N	Parameter	Soil samples						
	Physical	**S15**	**S16**	**S17**	**S18**	**S19**	**S20**	**S21**
1	pH (1: 20 suspension)	6.37	7.21	7.41	7.06	6.97	7.51	6.41
2	Conductance (mS/cm)	0.10	0.01	0.16	0.06	0.49	0.52	0.29
	Soil Texture (up to 60 cm)							
3	Sand (%)	81.5	81.2	80.0	81.4	81.1	81.1	77.0
4	Silt (%)	2.4	2.3	2.5	2.5	1.7	2.4	2.5
5	Clay (%)	16.1	16.5	17.5	16.1	17.2	16.5	20.5
6	Water Holding Capacity (%)	41.3	38.6	41.2	37.8	45.6	51.5	43.2
7	Bulk Density (g cm^{-3})	0.46	0.39	0.42	0.41	0.47	0.42	0.44
8	Hydraulic Conductivity (cm/min)	0.17	0.26	0.23	0.11	0.17	0.12	0.16
	Chemical							
9	Nitrogen (%)	0.13	0.24	0.16	0.12	0.18	0.07	0.14
10	Potassium (mg/kg)	2.1	3.2	3.6	4.7	3.3	3.3	3.6
11	Sodium (mg/kg)	3.2	4.7	4.1	2.9	3.2	3.3	2.9
12	Calcium (mg/kg)	18.3	32.2	42.5	15.1	14.8	18.3	25.1
13	Magnesium (mg/kg)	58.5	78.0	117.0	78.0	78.0	97.5	58.2
14	Phosphorous (mg/kg)	0.17	0.45	0.15	0.26	0.30	0.18	0.21
15	Sulphate(mg/kg)	35.1	27.0	23.1	16.5	15.1	34.9	33.25
16	Chloride (mg/kg)	16.0	12.4	14.2	15.9	14.8	8.4	8.8
17	Organic matter (%)	1.38	0.87	0.65	0.85	0.18	0.25	0.31
18	Oil and Grease (mg/kg)	1.6	5.1	2.8	1.6	2.1	5.2	1.9
	Heavy Metals							
19	Iron (g/kg)	102	103	115	84	128	108	95
20	Manganese (g/kg)	4.29	2.48	2.29	0.13	3.40	1.95	3.49
21	Zinc (mg/kg)	0.06	0.03	BDL	BDL	BDL	BDL	BDL
22	Lead (mg/kg)	BDL	BDL	0.02	BDL	0.25	0.20	0.07
23	Chromium (mg/kg)	0.01	0.19	0.22	0.05	0.36	0.22	0.07
24	Copper (mg/kg)	0.22	0.17	0.25	0.09	0.28	0.24	0.28
25	Cobalt (mg/kg)	0.12	0.14	0.23	0.07	0.12	0.17	0.11
26	Cadmium (mg/kg)	0.03	0.04	0.02	0.11	0.13	0.07	0.03

Table 5 Baseline data of Ambient Air Quality in the Study Area for the year of 2012 – 13 (Source: IOCL Guwahati)

PERIOD	AMBIENT AIR QUALITY MONITORING REPORT (Year 2012-13)												
		Concentration of Pollutants											
		PM $_{10}$ (μg/m^3)	PM $_{2.5}$ (μg/m^3)	SO_2 (μg/m^3)	NO_2 (μg/m^3)	NH_3 (μg/m^3)	O_3 (μg/m^3)	CO (mg/m^3)	Pb (μg/m^3)	Ni (ng/m^3)	As (ng/m^3)	Benzene (μg/m^3)	Benzo(a)pyrene (ng/m^3)
	Limit as per CPCB notification, New Delhi,18th Nov, 2009.for Ambient air quality	**100**	**60**	**80**	**80**	**400**	**180**	**2**	**1**	**20**	**6**	**5**	**1**
	Location : Adm Building												
July 12- Sept 12	**Max.**	65	34.5	13.15	31.5	29	BDL	0.46	0.055	11.6	BDL	4	BDL
	Min.	59	34	7	31	27.6	BDL	0.42	0.033	6	BDL	4	BDL
	Avg.	62	34	10	31	28	BDL	0.44	0.04	9	BDL	4	BDL
Oct 12 – Dec 12	**Max.**	95	59	12	56	52	BDL	0.84	0.12	13	BDL	4	BDL
	Min.	65	34	6	30	24	BDL	0.39	0.03	3	BDL	4	BDL
	Avg.	80	47	9	43	38	BDL	0.62	0.08	8	BDL	4	BDL
Jan 13 – Mar 13	**Max.**	95	52	8	51	32	BDL	1.00	0.07	8	BDL	BDL	BDL
	Min.	63	35	5	40	34	BDL	0.40	0.03	1	BDL	BDL	BDL
	Avg.	79	44	7	46	33	BDL	0.70	0.05	4	BDL	BDL	BDL
Average(Q2,Q3,Q4)		**74**	**41**	**8**	**40**	**33**	**BDL**	**0.6**	**0.06**	**7**	**BDL**	**4**	**BDL**
	Location : Guest House												
July 12- Sept 12	**Max.**	54	29	5	30	29	BDL	0.41	0.035	7.3	BDL	BDL	BDL
	Min.	51	27	4.4	28.3	22.1	BDL	0.36	0.03	6	BDL	BDL	BDL
	Avg.	53	28	5	29	26	BDL	0.38	0.03	7	BDL	BDL	BDL
Oct 12 – Dec 12	**Max.**	95	57	8	49	42	BDL	0.62	0.08	13	BDL	BDL	BDL
	Min.	56	27	6	26	22	BDL	0.32	0.02	4	BDL	BDL	BDL
	Avg.	76	42	7	38	32	BDL	0.47	0.05	8	BDL	BDL	BDL
Jan 13 – Mar 13	**Max.**	51	48	8	45	39	BDL	1.00	BDL	BDL	BDL	BDL	BDL
	Min.	27	27	5	26	22	BDL	0.40	BDL	BDL	BDL	BDL	BDL
	Avg.	39	38	7	36	31	BDL	0.45	BDL	BDL	BDL	BDL	BDL
Average(Q2,Q3,Q4)		**56**	**36**	**6**	**34**	**29**	**BDL**	**0.4**	**0.04**	**7.5**	**BDL**	**BDL**	**BDL**
	Location : Sector II												

July 12 – Sept 12	**Max.**	75	40	8.95	32	28.05	BDL	0.73	0.031	6.565	BDL	5	BDL
	Min.	58	33.5	7	30.5	28	BDL	0.34	0.025	5.94	BDL	3.34	BDL
	Avg.	67	37	8	31	28	BDL	0.53	0.028	6	BDL	4	BDL
Oct 12 – Dec 12	**Max.**	119	65	12	56	53	BDL	0.82	0.040	5	BDL	8	BDL
	Min.	57	30	5	27	27	BDL	0.34	0.020	4	BDL	4	BDL
	Avg.	88	48	8	41	40	BDL	0.58	0.030	5	BDL	6	BDL
Jan 13 - Mar13	**Max.**	99	51	11	50	36	BDL	0.80	BDL	BDL	BDL	BDL	BDL
	Min.	69	37	7	34	35	BDL	0.60	BDL	BDL	BDL	BDL	BDL
	Avg.	84	44	9	42	36	BDL	0.70	BDL	BDL	BDL	BDL	BDL
Average(Q2,Q3,Q4)		**80**	**43**	**8**	**38**	**35**	**BDL**	**0.6**	**0.03**	**5**	**BDL**	**5**	**BDL**
	Location : WTP												
July 12 – Sept 12	**Max.**	50	28	5	27	25	BDL	0.37	0.035	6.1	BDL	BDL	BDL
	Min.	45	24	4	26	23	BDL	0.26	0.025	5.89	BDL	BDL	BDL
	Avg.	48	26	5	27	24	BDL	0.31	0.03	6	BDL	BDL	BDL
Oct 12 – Dec 12	**Max.**	91	47	8	38	29	BDL	0.43	0.05	7	BDL	BDL	BDL
	Min.	46	22	4	35	27	BDL	0.32	0.03	4	BDL	BDL	BDL
	Avg.	69	35	6	36	28	BDL	0.38	0.04	5	BDL	BDL	BDL
Jan 13 – Mar 13	**Max.**	88	47	8	45	41	BDL	0.60	BDL	BDL	BDL	BDL	BDL
	Min.	52	29	5	22	30	BDL	0.39	BDL	BDL	BDL	BDL	BDL
	Avg.	70	38	6	34	35	BDL	0.49	BDL	BDL	BDL	BDL	BDL
Average(Q2,Q3,Q4)		**62**	**33**	**6**	**32**	**29**	**BDL**	**0.4**	**0**	**6**	**BDL**	**BDL**	**BDL**
	Note :	**BDL= Below Detections Limit :**											
	Detection Limit of O3 : 19.62 µg/m3,Ni: 1.0 ng/m3 As : 2 ng/ m3 , C_6H_6: 2.8 µg/m3 , Benzo(a)pyrene : 0.2 ng/m3 .												

Table 6: Ambient Air Monitoring Report: Quarter (Source: IOCLGuwahati)

AMBIENT AIR QUALITY MONITORING REPORT April'13-June'13

	Concentration of Pollutants											
	SO2	NO2	PM 10	PM 2.5	Ozone (O3)	Lead (Pb)	CO	Ammonia (NH3)	Benzene (C6H6)	Benzo(O) Pyrene	Arsenic (As)	Nickel (Ni)
	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	mg/m3	µg/m3	µg/m3	ng/m3	ng/m3	ng/m3
Limit as per CPCB notification, New Delhi,18th Nov, 2009.for Ambient air quality	80	80	100	60	100	1	2	400	5	1	6	20
Location : Adm Building												
Max.	6.0	33.5	91.4	55.0	BDL	0.1	0.9	36.4	6.5	BDL	BDL	9.6
Min.	4.0	19.7	47.0	27.0	BDL	0.0	0.4	19.6	BDL	BDL	BDL	3.3
Avg.	4.9	26.0	67.7	40.1	BDL	0.0	0.6	28.9	1.1	BDL	BDL	4.2
Location : Guest House												
Max.	5.6	29.1	80.0	51.0	BDL	0.1	0.6	39.1	5.6	BDL	BDL	7.4
Min.	4.0	14.9	40.0	24.0	BDL	0.00	0.2	15.5	BDL	BDL	BDL	0.0
Avg.	4.8	24.9	61.7	36.7	BDL	0.03	0.2	28.5	1.4	BDL	BDL	4.8
Location : Sector II												
Max.	6.4	31	99	58	BDL	0.10	0.8	41	5	BDL	BDL	12
Min.	4.0	18	47	21	BDL	0.00	0.3	22	bdl	BDL	BDL	0
Avg.	4.9	26	67	39	BDL	0.04	0.2	31	1	BDL	BDL	6
Location : WTP												
Max.	5.6	28.1	74.0	47.0	BDL	0.07	0.6	32.3	BDL	BDL	BDL	7.5
Min.	4.0	13.8	31.0	19.0	BDL	0.00	0.2	15.9	BDL	BDL	BDL	0.0
Avg.	4.4	21.2	50.3	31.2	BDL	0.03	0.4	25.4	BDL	BDL	BDL	4.5
Note :	BDL= Below Detections Limit :											
Note :	BDL= Below Detections Limit :											
Detection Limit of O3 : 19.62 µg/m3,Pb : 0.02 µg/m3, Ni: 1.0 ng/m3,As : 2 ng/ m3 , C_6H_6: 2.8 µg/m3 , Benzo(a)pyrene : 0.2 ng/m3 .												

AMBIENT AIR MONITORING REPORT					QUARTER July'13-Sept'13							
AMBIENT AIR QUALITY MONITORING REPORT												
	Concentration of Pollutants											
	SO2	NO2	PM 10	PM 2.5	Ozone (O3)	Lead (Pb)	CO	Ammonia (NH3)	Benzene (C6H6)	Benzo(O) Pyrene	Arsenic (As)	Nickel (Ni)
	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	mg/m3	µg/m3	µg/m3	ng/m3	ng/m3	ng/m3
Limit as per CPCB notification, New Delhi,18th Nov, 2009.for Ambient air quality	80	80	100	60	100	1	2	400	5	1	6	20
Location : Adm Building												
Max.	7.6	38.7	96.0	49.0	BDL	0.2	0.9	44.3	3.3	BDL	BDL	16.8
Min.	4.0	19.6	43.0	22.0	BDL	bdl	0.5	27.8	bdl	BDL	BDL	bdl
Avg.	5.2	25.8	61.9	31.7	BDL	0.0	0.6	32.5	3.2	BDL	BDL	7.3
Location : Guest House												
Max.	6.7	33.2	84.0	43.0	BDL	0.1	0.8	44.8	BDL	BDL	BDL	9.2
Min.	4.0	18.6	39.0	21.0	BDL	bdl	0.4	25.6	BDL	BDL	BDL	bdl
Avg.	5.0	26.0	59.1	30.6	BDL	0.03	0.6	33.2	BDL	BDL	BDL	4.8
Location : Sector II												
Max.	7.4	37	87	45	BDL	0.08	0.9	46	4	BDL	BDL	13
Min.	4.0	21	46	24	BDL	bdl	0.3	28	bdl	BDL	BDL	bdl
Avg.	5.6	27	66	34	BDL	0.03	0.5	36	3	BDL	BDL	7
Location : WTP												
Max.	6.7	33.2	84.0	43.0	BDL	BDL	0.6	40.2	BDL	BDL	BDL	9.2
Min.	4.0	14.6	37.0	19.0	BDL	BDL	0.2	23.4	BDL	BDL	BDL	bdl
Avg.	4.8	23.4	55.6	28.9	BDL	BDL	0.4	29.8	BDL	BDL	BDL	4.1
Note :	BDL= Below Detections Limit :											

Table 7 Surface Water Quality Data for the 2012-13 Year (Source: EIA report of Proposed INDAdeptG; IOCL Guwahati)

S.No	Surface water Parameters	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW17	SW18	SW19	SW20
1	Odor	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2	Temperature (oC)	22	22.1	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
3	Turbidity (NTU)	28	44	58	85	25	43	55	26	45	22	48	24	38	36	85	38	54	31	22	28
4	pH	7.79	8.52	8.36	8.69	8.78	8.51	8.86	8.16	7.71	7.98	8.18	8.17	8.2	8.11	8.11	8.52	8.45	8.62	8.11	8.2
5	Conductance (mS)	0.07	0.13	0.36	0.12	0.12	0.28	0.13	0.02	0.11	0.09	0.22	0.09	0.01	0.01	0.03	0.25	0.1	0.33	0.24	0.31
6	Total Dissolved Solid (mg/L)	118	188	245	232	192	101	122	184	416	202	210	179	214	149	127	145	135	228	94	57
7	Total Suspended Solid (mg/L)	267	161	277	229	230	133	131	130	222	146	236	242	261	251	152	233	177	182	265	167
8	Dissolved Oxygen (mg/L)	4.2	5	4.1	3	6	5.2	4.6	4.8	5.4	4.1	4.6	4.3	5.1	5.3	4.1	5.3	4.8	5.2	4.2	5
9	BOD ,3 days at 27 (mg/L)	11.1	14.6	8.2	11	6	11.2	10	14.6	14	6	12	8	16	6	14	16	11	14	16	14
10	COD (mg/L)	64	78	72	62	68	58	40	21.6	16	6.4	16.8	14.4	28	22.4	22.4	33	42	18	11	15.2
11	Oil & Grease (mg/L)	Nil	Nil	Nil	4	4.3	BDL	BDL	2.6	BDL	BDL	BDL	BDL	BDL	3.5	4.1	BDL	BDL	BDL	BDL	BDL
12	Total Kjeldahl Nitrogen (mg/L)	28.4	17.04	39.76	25.56	19.88	3.6	3.6	2.8	3.2	4.1	4.1	3.8	1.9	2.6	3.2	2.1	BDL	3.2	BDL	2.7
13	Chloride (mg/L)	28.4	17.04	39.76	25.56	19.88	14.2	19.88	25.56	22	22.72	36.92	22.72	17.04	11.36	17.04	36.92	11.36	48.28	28.4	27.5
14	Sulphates as SO4 (mg/L)	4	2.75	11.5	11.75	13.75	15	8.5	5.75	3.3	2	14.5	1.5	1.4	0.75	2.76	5.74	3.25	5.76	4.1	8.1
15	Nitrate (mg/L)	0.31	0.57	0.27	0.29	0.715	0.725	0.92	0.68	0.515	0.645	0.615	0.66	0.725	0.68	0.89	0.6	0.61	0.93	0.945	0.505
16	Phopsphate (mg/L)	0.2	0.235	0.165	0.2125	0.425	0.425	0.15	0.1775	0.16	0.19	0.3025	0.35	0.4175	0.4275	0.3275	0.66	0.6325	0.51	0.685	0.61
17	Fluoride (mg/L)	BDL	BDL	BDL	BDL	2.1	0.1	3.1	BDL	0.8	BDL	0.7	BDL	BDL	BDL	2.1	BDL	0.7	1.8	0.13	0.09
18	Cyanide (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Calcium (mg/L)	19.2	22.4	24.1	19.2	22.4	40.08	24.04	16.032	15.01	11.222	19.2	14.4	11.2	4.8	19.2	19.23	28.86	33.67	35.55	40.7
20	Mangesium (mg/L)	4.87	10.7	16.54	12.65	12.65	6.81	7.78	5.84	9.3	15.57	6.81	7.78	5.84	7.78	8.76	0.97	5.84	2.92	4.87	5.84
21	Sodium (mg/L)	21	16	15.8	14.7	22.8	14	18	12	15	12.4	8.6	9.2	7.6	11.2	10.5	14.6	8.4	11.2	22.2	21.2

22	Potassium (mg/L)	3.5	3.6	2.6	4.5	3.8	9.8	8.8	7.9	8.9	6.9	6.8	5.9	7	6.5	8.2	8.5	6.8	8.6	12.7	5.8
23	managanese (mg/L)	1.1	0.58	0.41	0.29	0.33	BDL	0.91	BDL	BDL	0.02	0.18	0.05	0.08	0.25	0.02	0.03	BDL	0.03	0.11	0.06
24	Zinc (mg/L)	BDL	0.02	BDL	BDL	0.02	BDL	BDL	BDL	BDL	BDL	0.23	0.1	0.21	0.31	0.21	0.08	0.12	0.21	0.1	0.12
25	Iron (mg/L)	0.29	2.8	BDL	BDL	0.78	0.37	0.33	0.34	0.01	0.39	0.12	BDL	BDL	BDL	BDL	0.009	BDL	BDL	BDL	BDL
26	Copper (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.22	0.07	0.46	0	BDL	1.472	3.02	0.51	1.01	0.22	0.45	0.58	0.32
27	Lead (Pb) (mg/L)	BDL	BDL	BDL	0.6	BDL	BDL	BDL	BDL	0.04	BDL	0.09	BDL	0.1	0.03	0.34	0.19	0.21	0.27	0.09	0.23
28	Chromium (VI) (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.81	BDL	BDL	BDL
29	Chromimum (Total) (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.38	0.23	0.13	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Cadmium (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.07	BDL	0.32	0.16	0.72	0.09	0.42	0.72	0.62	0.34	0.49	0.47
31	Arenic (µg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.03	0.07	0.09	BDL	0.02	BDL	BDL	BDL	BDL	BDL
32	Cobalt (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Nickel (mg/L)	BDL	0.02	BDL	BDL	BDL	BDL	BDL	0.6	0.4	0.11	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Phenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliform (MPN/100mL)	350	240	164	210	112	262	232	264	118	212	132	180	134	216	202	252	310	230	316	212
36	Feacal Coliform (MPN/mL)	210	170	110	121	NIL	30	NIL	10	21	12	41	28	10	11	NIL	36	28	17	NIL	NIL

Table 8 : Ground Water Quality Data for the 2012-13 Year
(Source: EIA report of Proposed INDAdept[G;] IOCL Guwahati)

Ground Water Parameters				
S.NO	Ground water Parameters	GW1	GW2	GW3
1	Odor	NS	NS	NS
2	Temperature (oC)	22.1	22	22
3	Turbidity (NTU)	9	7.3	7.4
4	pH	8.04	7.88	7.98
5	Conductance (mS/cm)	0.2	0.52	0.77
6	Total Dissolved Solid (mg/L)	205	167	145
7	Total Suspended Solid (mg/L)	20	14	11
8	Chloride (mg/L)	11.36	105.08	34.08
9	Sulphates as SO4 (mg/L)	2.1	11.73	8.1
10	Nitrate (mg/L)	0.56	0.94	0.41
11	Phosphate (mg/L)	0.46	0.39	0.34
12	Fluoride (mg/L)	0.02	BDL	BDL
13	Cyanide (mg/L)	BDL	BDL	BDL
14	Calcium (mg/L)	35.27	56.11	57.71
15	Magnesium (mg/L)	6.81	4.87	6.81
16	Sodium (mg/L)	8.5	7.1	7.3
17	potassium (mg/L)	3.9	3.5	2.8
18	Manganese (mg/L)	0.009	BDL	0.87
19	Zinc (mg/L)	0.32	0.01	BDL
20	Iron (mg/L)	0.59	0.32	0.11
21	Copper (mg/L)	BDL	0.02	BDL
22	Lead (Pb) (mg/L)	BDL	BDL	BDL
23	Chromium +6 (mg/L)	BDL	BDL	BDL
24	Chromium (Total) (mg/L)	BDL	0.06	BDL
25	Cadmium (mg/L)	BDL	BDL	BDL
26	Arsenic (	BDL	BDL	BDL
27	Cobalt (mg/L)	BDL	BDL	0.006
28	Nickel (mg/L)	BDL	BDL	BDL
29	Phenol	BDL	BDL	BDL
30	Total Coliform (MPN/100ml)	NIL	NIL	NIL
31	Faecal Coliform (MPN/100ml)	NIL	NIL	NIL

Table 9 : Noise Level Monitoring Report 2014 around INDMAX Unit (Source: IOCL Guwahati)

NOISE LEVEL MONITORING REPORT				
Date	**Area**	**Location**	**Average Exposure For An Employee Per Shift (Hrs)**	**Reading In dBA**
20/01/2014	**INDMAX**	Main Air Blower Area	1.00 hr	96.0
		INDMAX Field Control Room	8.0 hrs	66.0
28/04/2014	**INDMAX**	Main Air Blower Area	1.00 hr	95.0
		INDMAX Field Control Room	8.0 hrs	64.0

Table 10: Stack Emission Data 2013-14 INDMAX, mg/Nm³

(Source: IOCL Guwahati)

	Limit	Apr'13 Actual	May'13 Actual	June'13 Actual	Jul-13 Actual	Aug-13 Actual	Sep-13 Actual	Oct-13 Actual	Nov-13 Actual	Dec-13 Actual	Jan-14 Actual	Feb-14 Actual	Mar-14 Actual
SO_2	1700	69.9	94.2	105.1	141.8	175.0	158.0	145.7	236.0	122.0	102.5	94.0	105.0
NO_X	450	75.6	120.7	131.3	154.0	139.0	61.0	141.6	109.0	89.6	96.6	91.0	114.8
PM	100	95	84	97	80	78	78	85	7 7	65	70	63	72
CO (ppm)	400	3.1	3.3	2.3	3.2	3	3.8	4	7.9	8.6	8.2	5.5	6.2
Ni+V	5	0.0031 /BDL	0.0055/BDL	0.0059/BDL	0.0095/BDL	0.0112/BDL	0.0097/ BDL	0.0116/BDL	0.0112/BDL	BDL/ BDL	0.0116 /BDL	0.0112 /BDL	BDL/ BDL

ANNEXURE-XI:
WATER TESTING METHOD AND DESIREABLE LIMITS

भारतीय मानक

पीने का पानी — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

DRINKING WATER — SPECIFICATION

(Second Revision)

ICS 13.060.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 2012 **Price Group 6**

Drinking Water Sectional Committee, FAD 25

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Drinking Water Sectional Committee had been approved by the Food and Agriculture Division Council.

This standard was originally published in 1983. A report prepared by the World Health Organization in cooperation with the World Bank showed that in 1975, some 1 230 million people were without safe water supplies. These appalling facts were central to the United Nations decision to declare an International Drinking Water Supply and Sanitation decade, beginning in 1981. Further, the VI Five-Year Plan of India had made a special provision for availability of safe drinking water for the masses. Therefore, the standard was formulated with the objective of assessing the quality of water resources, and to check the effectiveness of water treatment and supply by the concerned authorities.

The first revision was undertaken to take into account the up-to-date information available about the nature and effect of various contaminants as also the new techniques for identifying and determining their concentration. Based on experience gained additional requirements for alkalinity; aluminium and boron were incorporated and the permissible limits for dissolved solids, nitrate and pesticides residues modified.

As per the eleventh five year plan document of India (2007-12), there are about 2.17 lakh quality affected habitations in the country with more than half affected with excess iron, followed by fluoride, salinity, nitrate and arsenic in that order. Further, approximately, 10 million cases of diarrhoea, more than 7.2 lakh typhoid cases and 1.5 lakh viral hepatitis cases occur every year a majority of which are contributed by unclean water supply and poor sanitation. The eleventh five year plan document of India (2007-2012) recognizes dealing with the issue of water quality as a major challenge and aims at addressing water quality problems in all quality affected habitations with emphasis on community participation and awareness campaigns as well as on top most priority to water quality surveillance and monitoring by setting up of water quality testing laboratories strengthened with qualified manpower, equipments and chemicals.

The second revision was undertaken to upgrade the requirements of the standard and align with the internationally available specifications on drinking water. In this revision assistance has been derived from the following:

a) EU Directives relating to the quality of water intended for human consumption (80/778/EEC) and Council Directive 98/83/EC.

b) USEPA standard — National Primary Drinking Water Standard. EPA 816-F-02-013 dated July, 2002.

c) WHO Guidelines for Drinking Water Quality. 3rd Edition Vol. 1 Recommendations, 2008.

d) Manual on Water Supply and Treatment, third edition — revised and updated May 1999, Ministry of Urban Development, New Delhi.

This standard specifies the acceptable limits and the permissible limits in the absence of alternate source. It is recommended that the acceptable limit is to be implemented as values in excess of those mentioned under 'Acceptable' render the water not suitable. Such a value may, however, be tolerated in the absence of an alternative source. However, if the value exceeds the limits indicated under 'permissible limit in the absence of alternate source' in col 4 of Tables 1 to 4, the sources will have to be rejected.

Pesticide residues limits and test methods given in Table 5 are based on consumption pattern, persistence and available manufacturing data. The limits have been specified based on WHO guidelines, wherever available. In cases where WHO guidelines are not available, the standards available from other countries have been examined and incorporated, taking in view the Indian conditions.

In this revision, additional requirements for ammonia, chloramines, barium, molybdenum, silver, sulphide, nickel, polychlorinated biphenyls and trihalomethanes have been incorporated while the requirements for colour, turbidity, total hardness, free residual chlorine, iron, magnesium, mineral oil, boron, cadmium, total arsenic, lead, polynuclear aromatic hydrocarbons, pesticides and bacteriological requirements have been modified.

In this revision, requirement and test method for virological examination have been included. Further, requirements and test methods for cryptosporidium and giardia have also been specified.

Routine surveillance of drinking water supplies should be carried out by the relevant authorities to understand the risk of specific pathogens and to define proper control procedures. The WHO Guidelines for Drinking Water Quality, 3rd Edition, Vol. 1 may be referred for specific recommendations on using a water safety approach incorporating risk identification. Precautions/Care should be taken to prevent contamination of drinking water from chlorine resistant parasites such as cryptosporidium species and giardia.

Indian Standard

DRINKING WATER — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for drinking water.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard the following definition shall apply.

3.1 Drinking Water — Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption.

4 REQUIREMENTS

Drinking water shall comply with the requirements given in Tables 1 to 4. The analysis of pesticide residues given in Table 3 shall be conducted by a recognized laboratory using internationally established test method meeting the residue limits as given in Table 5.

Drinking water shall also comply with bacteriological requirements (*see* **4.1**), virological requirements (*see* **4.2**) and biological requirements (*see* **4.3**).

4.1 Bacteriological Requirements

4.1.1 *Water in Distribution System*

Ideally, all samples taken from the distribution system including consumers' premises, should be free from coliform organisms and the following bacteriological quality of drinking water collected in the distribution system, as given in Table 6 is, therefore specified when tested in accordance with IS 1622.

4.2 Virological Requirements

4.2.1 Ideally, all samples taken from the distribution

Table 1 Organoleptic and Physical Parameters
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 3025	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Colour, Hazen units, *Max*	5	15	Part 4	Extended to 15 only, if toxic substances are not suspected in absence of alternate sources
ii)	Odour	Agreeable	Agreeable	Part 5	a) Test cold and when heated b) Test at several dilutions
iii)	*p*H value	6.5-8.5	No relaxation	Part 11	—
iv)	Taste	Agreeable	Agreeable	Parts 7 and 8	Test to be conducted only after safety has been established
v)	Turbidity, NTU, *Max*	1	5	Part 10	—
vi)	Total dissolved solids, mg/l, *Max*	500	2 000	Part 16	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Aluminium (as Al), mg/l, *Max*	0.03	0.2	IS 3025 (Part 55)	—
ii)	Ammonia (as total ammonia-N), mg/l, *Max*	0.5	No relaxation	IS 3025 (Part 34)	—
iii)	Anionic detergents (as MBAS) mg/l, *Max*	0.2	1.0	Annex K of IS 13428	—
iv)	Barium (as Ba), mg/l, *Max*	0.7	No relaxation	Annex F of IS 13428* or IS 15302	—
v)	Boron (as B), mg/l, *Max*	0.5	1.0	IS 3025 (Part 57)	—
vi)	Calcium (as Ca), mg/l, *Max*	75	200	IS 3025 (Part 40)	—
vii)	Chloramines (as Cl_2), mg/l, *Max*	4.0	No relaxation	IS 3025 (Part 26)* or APHA 4500-Cl G	—
viii)	Chloride (as Cl), mg/l, *Max*	250	1 000	IS 3025 (Part 32)	—
ix)	Copper (as Cu), mg/l, *Max*	0.05	1.5	IS 3025 (Part 42)	—
x)	Fluoride (as F) mg/l, *Max*	1.0	1.5	IS 3025 (Part 60)	—
xi)	Free residual chlorine, mg/l, *Min*	0.2	1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l
xii)	Iron (as Fe), mg/l, *Max*	0.3	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xiii)	Magnesium (as Mg), mg/l, *Max*	30	100	IS 3025 (Part 46)	—
xiv)	Manganese (as Mn), mg/l, *Max*	0.1	0.3	IS 3025 (Part 59)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xv)	Mineral oil, mg/l, *Max*	0.5	No relaxation	Clause **6** of IS 3025 (Part 39) Infrared partition method	—
xvi)	Nitrate (as NO_3), mg/l, *Max*	45	No relaxation	IS 3025 (Part 34)	—
xvii)	Phenolic compounds (as C_6H_5OH), mg/l, *Max*	0.001	0.002	IS 3025 (Part 43)	—
xviii)	Selenium (as Se), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 56) or IS 15303*	—
xix)	Silver (as Ag), mg/l, *Max*	0.1	No relaxation	Annex J of IS 13428	—
xx)	Sulphate (as SO_4) mg/l, *Max*	200	400	IS 3025 (Part 24)	May be extended to 400 provided that Magnesium does not exceed 30
xxi)	Sulphide (as H_2S), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 29)	—
xxii)	Total alkalinity as calcium carbonate, mg/l, *Max*	200	600	IS 3025 (Part 23)	—
xxiii)	Total hardness (as $CaCO_3$), mg/l, *Max*	200	600	IS 3025 (Part 21)	—
xxiv)	Zinc (as Zn), mg/l, *Max*	5	15	IS 3025 (Part 49)	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

Table 3 Parameters Concerning Toxic Substances

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Cadmium (as Cd), mg/l, *Max*	0.003	No relaxation	IS 3025 (Part 41)	—
ii)	Cyanide (as CN), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 27)	—
iii)	Lead (as Pb), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 47)	—
iv)	Mercury (as Hg), mg/l, *Max*	0.001	No relaxation	IS 3025 (Part 48)/ Mercury analyser	—
v)	Molybdenum (as Mo), mg/l, *Max*	0.07	No relaxation	IS 3025 (Part 2)	—
vi)	Nickel (as Ni), mg/l, *Max*	0.02	No relaxation	IS 3025 (Part 54)	—
vii)	Pesticides, µg/l, *Max*	See Table 5	No relaxation	See Table 5	—
viii)	Polychlorinated biphenyls, mg/l, *Max*	0.000 5	No relaxation	ASTM 5175*	— or APHA 6630
ix)	Polynuclear aromatic hydro-carbons (as PAH), mg/l, *Max*	0.000 1	No relaxation	APHA 6440	—
x)	Total arsenic (as As), mg/l, *Max*	0.01	0.05	IS 3025 (Part 37)	—
xi)	Total chromium (as Cr), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 52)	—
xii)	Trihalomethanes:				
	a) Bromoform, mg/l, *Max*	0.1	No relaxation	ASTM D 3973-85* or APHA 6232	—
	b) Dibromochloromethane, mg/l, *Max*	0.1	No relaxation	ASTM D 3973-85* or APHA 6232	—
	c) Bromodichloromethane, mg/l, *Max*	0.06	No relaxation	ASTM D 3973-85* or APHA 6232	—
	d) Chloroform, mg/l, *Max*	0.2	No relaxation	ASTM D 3973-85* or APHA 6232	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 4 Parameters Concerning Radioactive Substances

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 14194	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Radioactive materials:				
	a) Alpha emitters Bq/l, *Max*	0.1	No relaxation	Part 2	—
	b) Beta emitters Bq/l, *Max*	1.0	No relaxation	Part 1	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under ‘permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 5 Pesticide Residues Limits and Test Method

(*Foreword* and *Table* 3)

Sl No.	Pesticide	Limit µg/l	Method of Test, Ref to	
			USEPA	AOAC/ ISO
(1)	(2)	(3)	(4)	(5)
i)	Alachlor	20	525.2, 507	—
ii)	Atrazine	2	525.2, 8141 A	—
iii)	Aldrin/ Dieldrin	0.03	508	—
iv)	Alpha HCH	0.01	508	—
v)	Beta HCH	0.04	508	—
vi)	Butachlor	125	525.2, 8141 A	—
vii)	Chlorpyriphos	30	525.2, 8141 A	—
viii)	Delta HCH	0.04	508	—
ix)	2,4- Dichlorophenoxyacetic acid	30	515.1	—
x)	DDT (*o, p* and *p, p* – Isomers of DDT, DDE and DDD)	1	508	AOAC 990.06
xi)	Endosulfan (alpha, beta, and sulphate)	0.4	508	AOAC 990.06
xii)	Ethion	3	1657 A	—
xiii)	Gamma — HCH (Lindane)	2	508	AOAC 990.06
xiv)	Isoproturon	9	532	—
xv)	Malathion	190	8141 A	—
xvi)	Methyl parathion	0.3	8141 A	ISO 10695
xvii)	Monocrotophos	1	8141 A	—
xviii)	Phorate	2	8141 A	—

NOTE — Test methods are for guidance and reference for testing laboratory. In case of two methods, USEPA method shall be the reference method.

Table 6 Bacteriological Quality of Drinking Water[1)]

(*Clause* 4.1.1)

Sl No.	Organisms	Requirements
(1)	(2)	(3)
i)	*All water intended for drinking*:	
	a) *E. coli* or thermotolerant coliform bacteria[2), 3)]	Shall not be detectable in any 100 ml sample
ii)	*Treated water entering the distribution system*:	
	a) *E. coli* or thermotolerant coliform bacteria[2)]	Shall not be detectable in any 100 ml sample
	b) Total coliform bacteria	Shall not be detectable in any 100 ml sample
iii)	*Treated water in the distribution system*:	
	a) *E. coli* or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample
	b) Total coliform bacteria	Shall not be detectable in any 100 ml sample

[1)] Immediate investigative action shall be taken if either *E.coli* or total coliform bacteria are detected. The minimum action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause shall be determined by immediate further investigation.

[2)] Although, *E. coli* is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests shall be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies.

[3)] It is recognized that, in the great majority of rural water supplies in developing countries, faecal contamination is widespread. Under these conditions, the national surveillance agency should set medium-term targets for progressive improvement of water supplies.

system including consumers' premises, should be free from virus.

4.2.2 None of the generally accepted sewage treatment methods yield virus-free effluent. Although a number of investigators have found activated sludge treatment to be superior to trickling filters from this point of view, it seems possible that chemical precipitation methods will prove to be the most effective.

4.2.3 Virus can be isolated from raw water and from springs, enterovirus, reovirus, and adenovirus have been found in water, the first named being the most resistant to chlorination. If enterovirus are absent from chlorinated water, it can be assumed that the water is safe to drink. Some uncertainty still remains about the virus of infectious hepatitis, since it has not so far been isolated but in view of the morphology and resistance of enterovirus it is likely that, if they have been inactivated hepatitis virus will have been inactivated also.

4.2.4 An exponential relationship exists between the rate of virus inactivation and the redox potential. A redox potential of 650 mV (measured between platinum and calomel electrodes) will cause almost instantaneous inactivation of even high concentrations of virus. Such a potential can be obtained with even a low concentration of free chlorine, but only with an extremely high concentration of combined chlorine. This oxidative inactivation may be achieved with a number of other oxidants also, for example, iodine, ozone and potassium permanganate, but the effect of the oxidants will always be counteracted, if reducing components, which are mainly organic, are present. As a consequence, the sensitivity of virus towards disinfectants will depend on the *milieu* just as much as on the particular disinfectant used.

4.2.5 Viruses are generally resistant to disinfectants as well as get protected on account of presence of particulate and organic matter in water. Because the difference between the resistance of coliform organisms and of virus to disinfection by oxidants increases with increasing concentration of reducing components, for example, organic matter, it cannot be assumed that the absence of available coliform organisms implies freedom from active virus under circumstances where a free chlorine residual cannot be maintained. Sedimentation and slow sand filtration in themselves may contribute to the removal of virus from water.

4.2.6 In practice, >0.5 mg/l of free chlorine for 1 h is sufficient to inactivate virus, even in water that was originally polluted provided the water is free from particulates and organic matter.

4.2.7 MS2 phage are indicator of viral contamination in drinking water. MS2 phage shall be absent in 1 litre of water when tested in accordance with USEPA method 1602. If MS2 phage are detected in the drinking water, virological examination shall be done by the Polymerase Chain Reaction (PCR) method for virological examination as given in Annex B. USEPA method in Manual of Method for Virology Chapter 16, June 2001 shall be the alternate method. If viruses are detected, the cause shall be determined by immediate further investigation.

4.3 Biological Requirements

4.3.1 Ideally, all samples taken including consumers premises should be free from biological organisms. Biological examination is of value in determining the causes of objectionable tastes and odours in water and controlling remedial treatments, in helping to interpret the results of various chemical analysis, and in explaining the causes of clogging in distribution pipes and filters. In some instances, it may be of use in demonstrating that water from one source has been mixed with that from another.

4.3.2 The biological qualities of water are of greater importance when the supply has not undergone the conventional flocculation and filtration processes, since increased growth of methane-utilizing bacteria on biological slimes in pipes may then be expected, and the development of bryozoal growths such as *Plumatella* may cause operational difficulties.

4.3.3 Some of the animalcules found in water mains may be free-living in the water, but others such as *Dreissena* and *Asellus* are more or less firmly attached to the inside of the mains. Although these animalcules are not themselves pathogenic, they may harbour pathogenic organisms or virus in their intestines, thus protecting these pathogens from destruction by chlorine.

4.3.4 Chlorination, at the dosages normally employed in waterworks, is ineffective against certain parasites, including amoebic cysts; they can be excluded only by effective filtration or by higher chlorine doses than can be tolerated without subsequent dechlorination. *Amoebiasis* can be conveyed by water completely free from enteric bacteria; microscopic examination after concentration is, therefore, the only safe method of identification.

4.3.5 Strict precautions against back-syphonage and cross-connections are required, if amoebic cysts are found in a distribution system containing tested water.

4.3.6 The *cercariae of schistosomiasis* can be detected by similar microscopic examination, but there is, in any case, no evidence to suggest that this disease is normally spread through piped water supplies.

4.3.7 The cyclops vector of the embryos of *Dracunculus medinensis* which causes dracontiasis or Guinea-worm disease can be found in open wells in a number of tropical areas. They are identifiable by microscopic examination. Such well supplies are frequently used untreated, but the parasite can be relatively easily excluded by simple physical improvements in the form of curbs, drainage, and apron surrounds and other measures which prevent physical contact with the water source.

4.3.8 Cryptosporidium shall be absent in 10 liter of water when tested in accordance with USEPA method 1622 or USEPA method 1623* or ISO 15553 : 2006.

4.3.9 Giardia shall be absent in 10 liter of water when tested in accordance with USEPA method 1623* or ISO 15553 : 2006.

4.3.10 The drinking water shall be free from microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin producing organisms. An illustrative (and not exhaustive) list is given in Annex C for guidance.

NOTE — In case of dispute, the method indicated by '*' in **4.3.8** and **4.3.9** shall be referee method.

5 SAMPLING

Representative samples of water shall be drawn as prescribed in IS 1622 and IS 3025 (Part 1).

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1622 : 1981	Methods of sampling and microbiological examination of water (*first revision*)
3025	Methods of sampling and test (physical and chemical) for water and waste water:
(Part 1) : 1987	Sampling (*first revision*)
(Part 2) : 2002	Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy
(Part 4) : 1983	Colour (*first revision*)
(Part 5) : 1983	Odour (*first revision*)
(Part 7) : 1984	Taste threshold (*first revision*)
(Part 8) : 1984	Tasting rate (*first revision*)
(Part 10) : 1984	Turbidity (*first revision*)
(Part 11) : 1983	*p*H value (*first revision*)
(Part 16) : 1984	Filterable residue (total dissolved solids) (*first revision*)
(Part 21) : 1983	Total hardness (*first revision*)
(Part 23) : 1983	Alkalinity (*first revision*)
(Part 24) : 1986	Sulphates (*first revision*)
(Part 26) : 1986	Chlorine residual (*first revision*)
(Part 27) : 1986	Cyanide (*first revision*)
(Part 29) : 1986	Sulphide (*first revision*)
(Part 32) : 1988	Chloride (*first revision*)
(Part 34) : 1988	Nitrogen (*first revision*)
(Part 37) : 1988	Arsenic (*first revision*)
(Part 39) : 1989	Oil and grease
(Part 40) : 1991	Calcium
(Part 41) : 1992	Cadmium (*first revision*)
(Part 42) : 1992	Copper (*first revision*)
(Part 43) : 1992	Phenols (*first revision*)
(Part 46) : 1994	Magnesium
(Part 47) : 1994	Lead
(Part 48) : 1994	Mercury
(Part 49) : 1994	Zinc
(Part 52) : 2003	Chromium
(Part 53) : 2003	Iron
(Part 54) : 2003	Nickel
(Part 55) : 2003	Aluminium
(Part 56) : 2003	Selenium
(Part 57) : 2005	Boron
(Part 59) : 2006	Manganese
(Part 60) : 2008	Fluoride
13428 : 2003	Packaged natural mineral water — Specification (*first revision*)
14194	Radionuclides in environmental samples — Method of estimation:
(Part 1) : 1994	Gross beta activity measurement
(Part 2) : 1994	Gross alpha activity measurement
15302 : 2002	Determination of aluminium and barium in water by direct nitrous oxide-acetylene flame atomic absorption spectrometry
15303 : 2002	Determination of antimony, iron and selenium in water by electrothermal atomic absorption spectrometry

ANNEX B

(*Clause* 4.2.7)

POLYMERASE CHAIN REACTION (PCR) METHOD

B-1 GENERAL

The method involves the concentration of viruses from 100 litre of drinking water to 1 ml by membrane filter technique. The concentrate is subjected to amplification using polymerase chain reaction (PCR) and primers based on highly conserved regions of viral genomes. This method can detect as low as 10 genome copies. Stringent precautions are needed to avoid contamination with amplified DNA products leading to false positive reactions. Detection of hepatitis A virus (HAV) RNA and enterovirus (EV) RNA is considered as an indication of presence of viruses in water. Steps involved include concentration of water, RNA extraction, complementary DNA (cDNA) synthesis and PCR.

B-2 CONCENTRATION OF DRINKING WATER

B-2.1 Apparatus

B-2.1.1 *Pressure Pump*

B-2.1.2 *Membrane Filter Assembly with 144 mm Diameter with Tripod Stand*

B-2.1.3 *Pressure Vessel (50 litre capacity) with Pressure Gauge*

B-2.1.4 *Inter-connecting Pressure Tubes*

B-2.2 Reagents

Autoclaved double distilled water shall be used for the preparation of reagents/buffers in this study.

B-2.2.1 *Aluminium Chloride*

B-2.2.2 *HCl/NaOH Urea (Extra Pure)*

B-2.2.3 *Disodium Hydrogen Phosphate* ($Na_2HPO_4.2H_2O$) — 0.2 M, filter sterilized.

B-2.2.4 *Sodium Dihydrogen Phosphate* ($NaH_2PO_4.2H_2O$) — 0.2 M, filter sterilized.

B-2.2.5 *Citric Acid* — 0.1 M, filter sterilized.

B-2.2.6 *L-Arginine* — 0.5 M, filter sterilized.

B-2.2.7 *Urea-Arginine Phosphate Buffer* (*U-APB*) — Mix 4.5 g of urea with 2 ml of 0.2 M NaH_2PO_4 and 2 ml of 0.5 M L - Arginine and make up the volume to 50 ml with sterile distilled water. The *p*H of the eluent shall be 9.0.

B-2.2.8 *Magnesium Chloride* ($MgCl_2$) — 1 M.

B-2.2.9 *McII Vaines Buffer* (*p*H *5.0*) — Mix 9.7 ml of 0.1 M citric acid with 10.3 ml of 0.2 M $Na_2HPO_4.2H_2O$ under sterile conditions.

B-2.3 Procedure

Filter 100 litre of drinking water sample through membrane filter assembly using either positively charged membrane of 144 mm diameter or 0.22 micron diameter pore size nitrocellulose membrane. For positively charged membrane the test water *p*H need not be adjusted. But for the 0.22 micron nitrocellulose membrane adjust the *p*H to 3.5 after adding the aluminium chloride as a coagulant to a final concentration of 0.000 5 M.

At lower *p*H pass the water through the membrane. The flow rate shall be 40 litre/h approximately. After the completion of the filtration, elute the adsorbed particles using 100 ml of urea-arginine phosphate buffer (U-APB). Precipitate the suspended particles using 1 ml of magnesium chloride (1 M). Dissolve the resultant precipitate centrifuged out of the sample in 800-1.0 ml of McII vaines buffer. The processed sample can be stored at refrigerator until required.

B-3 RNA EXTRACTION

B-3.1 Apparatus

B-3.1.1 *Cooling Centrifuge*

B-3.1.2 *Deep Freezer (–20°C)*

B-3.1.3 *Vortex Mixer*

B-3.1.4 *Pipette Man*

B-3.2 Reagents

B-3.2.1 *Cetyl Trimethyl Ammonium Bromide (CTAB) Buffer*

CTAB	:	1 percent
Sodium Dodecyl Sulphate (SDS)	:	1 percent
EDTA	:	20 mM
Sodium Chloride	:	1 M

B-3.2.2 *Phenol, Chloroform and Isoamylalcohol in the ratio of 25:24:1 (PCI)*

B-3.2.3 *Ethanol*

B-3.2.4 *TE Buffer (p*H *8.0)*

Tris base	:	1 M
EDTA	:	0.5 M

B-3.2.5 *Sodium Acetate* — 3 M.

B-3.3 Procedure

Treat 300 µl of concentrated water sample with equal volume of CTAB and 1/10th volume of PCI. Vortex and centrifuge at 5 000 × g for 30 min at 4°C. Add 1/10th volume of 3 M sodium acetate and double the volume of cold ethanol to the aqueous layer. Keep the mixture at either at –20°C for overnight or in liquid nitrogen for 2-5 min. Centrifuge at 10 000 × g, for 30 min at 4°C. Discard the supernatant and air dry the pellet and dissolve it in 20 µl TE buffer.

B-4 COMPLEMENTARY DNA (c DNA) SYNTHESIS

B-4.1 Apparatus

B-4.1.1 *PCR Machine*

B-4.1.2 *Deep Freezer (–20°C)*

B-4.2 Reagents

B-4.2.1 *cDNA Synthesis Kit*

B-4.3 Procedure

Suspend the extracted RNA in 20 µl of cDNA reaction mixture, which consists of 4 µl of 5X reverse transcriptase reaction buffer [250 mM TRIS–HCl (*p*H 8.5), 40 mM KCl, 150 mM $MgCl_2$, 5 mM dithiothreitol (DTT)], 0.5 µl of 10 mM deoxynucleotide phosphate (dNTP), 2 µl of hexa nucleotide mixture, 1 µl of 25 U of Maloney Murine Leukaemia Virus (M-MuLV) reverse transcriptase, 0.5 µl of 20 U of human placental RNase inhibitor. Heat the reaction mixture to 95°C for 5 min and rapidly chill on ice, this is followed by the addition of 1 µl (25 U/µl) of M-MuLV reverse transcriptase. Incubate the reaction mixture as given by the manufacturer of the kit and quickly chill the reaction tube on ice.

B-5 PCR AMPLIFICATION

B-5.1 Apparatus

B-5.1.1 *PCR Machine*

B-5.1.2 *Deep Freezer (–20°C)*

B-5.1.3 *Micropippette*

B-5.2 Reagents

B-5.2.1 *Primers for EV and HAV*

EV sense primer, 5' — TCC TCC GGC CCC TGA ATG CG — 3'
antisense primer, 5' — ATT GTC ACC ATA AGC AGC CA — 3'

HAV sense primer, 5' — GTTTT GCTCC TCTTT ATCAT GCTAT G-3'
antisense primer, 5' — GGAAA TGTCT CAGGT ACTTT CTTTG-3'

B-5.2.2 *PCR Master Mix*

B-5.2.3 *Mineral Oil*

B-5.3 Procedure

B-5.3.1 *PCR Amplification for Hepatitis A Virus (HAV)*

In 5 µl of cDNA, add 95 µl of a PCR Master Mix (10 mM TRIS–HCl (*p*H 8.3), 50 mM KCl, 2.5 mM $MgCl_2$, 0.01 percent gelatin (1× PCR buffer), 200 µM of each dNTP, 1.5 U of *Thermus aquaticus* polymerase). Add 25 pico moles of sense and antisense oligonucleotide primers of HAV and overlay with mineral oil. Appropriate positive and negative controls shall be included with each run. Set the following reaction at thermo cycler:

Denaturation at 94°C for 2 min

Denaturation for	1.0 min	at 94°C	35 cycles
Annealing for	1.0 min	at 57°C	
Extension for	1.3 min	at 72°C	

Final extension at 72°C for 7 min.

B-5.3.2 *PCR Amplification for Enterovirus (EV)*

In 5 µl of cDNA, add 95 µl of a PCR Master Mix (10 mM TRIS–HCl (*p*H 8.3), 50 mM KCl, 2.5 mM $MgCl_2$, 0.01 percent gelatin (1X PCR buffer), 200 µM of each dNTP, 1.5 U of *Thermus aquaticus* polymerase). Add 25 pico moles of sense and antisense oligonucleotide primers of EV and overlay with mineral oil. Appropriate positive and negative controls shall be included with each run. Set the following reaction at thermo cycler:

Denaturation at 94°C for 2 min

Denaturation for	1.0 min	at 94°C	35 cycles
Annealing for	1.0 min	at 42°C	
Extension for	2.0 min	at 72°C	

Final extension at 72°C for 7 min.

B-6 AGAROSE GEL ELECTROPHORESIS

B-6.1 Apparatus

B-6.1.1 *Micropippette*

B-6.1.2 *Electrophoresis Apparatus*

B-6.1.3 *Gel Documentation System*

B-6.2 Reagents

B-6.2.1 *Running Buffer* — 50X TAE buffer

Tris base/Tris buffer : 121.00 g

Glacial acetic acid	:	28.55 ml
0.5 M EDTA	:	50 .00 ml
Distilled water (autoclaved)	:	300.45 ml

Make the final volume upto 1 000 ml with deionised distilled water, sterilize and store at 4°C. The final concentration for the preparation of agarose gel and to run the gel shall be 1X.

B-6.2.2 *Tracking Dye* — 6X bromophenol blue.

B-6.2.3 *Ethidium Bromide* — 0.5 µg/ml.

B-6.3 Procedure

Run the PCR amplified product of EV and HAV on 1.5 percent agarose gel using 1X TAE buffer. Load 10 µl of amplified product after mixing it with 1 µl 10X loading dye. Run the molecular weight marker along with the samples. Run the electrophoresis at 100 V for 30 min. Stain the gel with ethidium bromide (0.5 µl/ml) for 20 min. Wash it with distilled water and view under UV transilluminator and photograph the gel to analyse the band pattern. EV gives the band as 155 base pair and the HAV gives band as 225 base pair.

ANNEX C

(*Clause* 4.3.10)

ILLUSTRATIVE LIST OF MICROSCOPIC ORGANISMS PRESENT IN WATER

Sl No. (1)	*Classification of Microscopic Organism* (2)	*Group and Name of the Organism* (3)	*Habitat* (4)	*Effect of the Organisms and Significance* (5)
i)	Algae	a) Chlorophyceae:		
		1) *Species of* Coelastrum, Gomphospherium, Micractinium, Mougeotia, Oocystis, Euastrum, Scenedesmus, Actinastrum, Gonium, Eudorina Pandorina, Pediastrum, Zygnema, Chlamydomonas, Careteria, Chlorella, Chroococcus, Spirogyra, Tetraedron, Chlorogonium, Stigeoclonium	Polluted water, impounded sources	Impart colouration
		2) *Species of* Pandorina, Volvox, Gomphospherium, Staurastrum, Hydrodictyon, Nitella	Polluted waters	Produce taste and odour
		3) *Species of* Rhizoclonium, Cladothrix, Ankistrodesmus, Ulothrix, Micrasterias, Chromulina	Clean water	Indicate clean condition
		4) *Species of* Chlorella, Tribonema, Clostrium, Spirogyra, Palmella	Polluted waters, impounded sources	Clog filters and create impounded difficulties
		b) Cyanophyceae:		
		1) *Species of* Anacystis and Cylindrospermum	Polluted waters	Cause water bloom and impart colour
		2) *Species of* Anabena, Phormidium, Lyngbya, Arthrospira, Oscillatona	Polluted waters	Impart colour
		3) *Species of* Anabena, Anacystis, Aphanizomenon	Polluted waters, impounded sources	Produce taste and odour
		4) *Species of* Anacystis, Anabena, Coelospherium, Cleotrichina, Aphanizomenon	Polluted waters	Toxin producing
		5) *Species of* Anacystis, Rivularia, Oscillatoria, Anabena	Polluted waters	Clog filters

Sl No.	*Classification of Microscopic Organism*	*Group and Name of the Organism*	*Habitat*	*Effect of the Organisms and Significance*
(1)	(2)	(3)	(4)	(5)
		6) *Species of* Rivularia	Calcareous waters and also rocks	Bores rocks and calcareous strata and causes matted growth
		7) *Species of* Agmenellum, Microcoleus, Lemanea	Clean waters	Indicators of purification
		c) Diatoms (Bacillareophyceae):		
		1) *Species of* Fragillaria, Stephanodiscus, Stauroneis	—	Cause discoloration
		2) *Species of* Asterionella, Tabellaria	Hill streams high altitude, torrential and temperate waters	Taste and odour producing clog filters
		3) *Species of* Synedra and Fragillavia	Polluted waters	Taste and odour producing
		4) *Species of* Nitzchia, Gomphonema	Moderately polluted waters	Cause discoloration
		5) *Species of* Cymbela, Synedra, Melosira, Navicula, Cyclotella, Fragillaria, Diatoma, Pleurogsigma	Rivers and streams impounded sources	Clog filters and cause operational difficulties
		6) *Species of* Pinmularia, Surinella, Cyclotella, Meridion, Cocconeis	Clean waters	Indicators of purification
		d) Xanthophyceae:		
		Species of Botryococcus	Hill streams, high altitude and temperate waters	Produces coloration
ii)	Zooplankton	a) Protozoa:		
		1) Amoeba, Giardia Lamblia Arcella, Difflugia, Actinophrys	Polluted waters	Pollution indicators
		2) Endamoeba, Histolytica	Sewage and activated sludge	Parasitic and pathogenic
		b) Ciliates:		
		Paramoecium, Vorticella, Carchesium, Stentor, Colpidium, Coleps, Euplotes, Colopoda, Bodo	Highly polluted waters, sewage and activated sludge	Bacteria eaters
		c) Crustacea:		
		1) Bosmina, Daphnia	Stagnant polluted waters	Indicators of pollution
		2) Cyclops	Step wells in tropical climate	Carrier host of guinea worm
iii)	Rotifers	a) Rotifers:		
		Anurea, Rotaria, Philodina	Polluted and Algae laden waters	Feed on algae
		b) Flagellates:		
		1) Ceratium, Glenodinium, Peridinium Dinobryon	Rocky strata, iron bearing and acidic waters	Impart colour and fishy taste
		2) Euglena, Phacus	Polluted waters	Impart colour

Sl No.	*Classification of Microscopic Organism*	*Group and Name of the Organism*	*Habitat*	*Effect of the Organisms and Significance*
(1)	(2)	(3)	(4)	(5)
iv)	Miscellaneous Organisms	a) Sponges, Hydra	Fresh water	Clog filters and affect purification systems
		b) Tubifex, Eristalls, Chironomids	Highly polluted waters, sewage and activated sludge and bottom deposits	Clog filters and render water unaesthetic
		c) Plumatella	Polluted waters	Produces biological slimes and causes filter operational difficulties
		c) Dreissena, Asellus	Polluted waters	Harbour pathogenic organisms

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Eastern :	1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern :	SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 3843 60 9285
Southern :	C.I.T. Campus, IV Cross Road, CHENNAI 600113	2254 1216, 2254 1442 2254 2519, 2254 2315
Western :	Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	2832 9295, 2832 7858 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

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ANNEXURE-XII:

NATIONAL AMBIENT AIR QUALITY STANDARD

रजिस्ट्री सं॰ डी॰ एल॰-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

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No. 217] NEW DELHI, WEDNESDAY, NOVEMBER 18, 2009/KARTIKA 27, 1931

राष्ट्रीय परिवेशी वायु गुणवत्ता मानक

केन्द्रीय प्रदूषण नियंत्रण बोर्ड

अधिसूचना

नई दिल्ली, 18 नवम्बर, 2009

सं. बी-29016/20/90/पी.सी.आई.-I.—वायु (प्रदूषण निवारण एवं नियंत्रण) अधिनियम, 1981 (1981 का 14) की धारा 16 की उपधारा (2) (एच) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए तथा अधिसूचना संख्या का.आ. 384(ई), दिनांक 11 अप्रैल, 1994 और का.आ. 935 (ई) दिनांक 14 अक्तूबर, 1998 के अधिक्रमण में केन्द्रीय प्रदूषण नियंत्रण बोर्ड इसके द्वारा तत्काल प्रभाव से राष्ट्रीय परिवेशी वायु गुणवत्ता मानक अधिसूचित करता है, जो इस प्रकार है:-

राष्ट्रीय परिवेशी वायु गुणवत्ता मानक

क्र. सं.	प्रदूषक	समय आधारित औसत	परिवेशी वायु में सान्द्रण		
			औद्योगिक, रिहायशी, ग्रामीण और अन्य क्षेत्र	पारिस्थितिकीय संवेदनशील क्षेत्र (केन्द्र सरकार द्वारा अधिसूचित)	प्रबोधन की पद्धति
(1)	(2)	(3)	(4)	(5)	(6)
1	सल्फर डाई आक्साइड (SO_2), $\mu g/m^3$	वार्षिक* 24 घंटे**	50 80	20 80	-उन्नत वेस्ट और गाईक -पराबैंगनी परिदीप्ती
2	नाइट्रोजन डाई आक्साइड (NO_2), $\mu g/m^3$	वार्षिक* 24 घंटे**	40 80	30 80	-उपांतरित जैकब और हॉचाइजर (सोडियम-आर्सेनाईट) -रासायनिक संदीप्ति
3	विविक्त पदार्थ (10माइक्रान से कम आकार)या PM_{10}, $\mu g/m^3$	वार्षिक* 24 घंटे**	60 100	60 100	-हरात्मक विश्लेषण -टोयम -बीटा तनुकरण पद्धति

4	विविक्त पदार्थ (2.5 माइक्रान से कम आकार या $PM_{2.5}$, $\mu g/m^3$	वार्षिक* 24 घंटे**	40 60	40 60	-हरात्मक विश्लेषण -टोयम -बीटा तनुकरण पद्धति
5	ओजोन (O_3) $\mu g/m^3$	8 घंटे** 1 घंटा**	100 180	100 180	-पराबैंगनी द्वीप्तिकाल -रासायनिक संदीप्ति -रासायनिक पद्धति
6	सीसा (Pb) $\mu g/m^3$	वार्षिक* 24 घंटे**	0.50 1.0	0.50 1.0	ई.पी.एम 2000 या समरूप फिल्टर पेपर का प्रयोग करके AAS/ICP पद्धति -टेफलॉन फिल्टर पेपर का प्रयोग करते हुए ED-XRF
7	कार्बन मोनोक्साइड (CO) mg/m^3	8 घंटे** 1 घंटा**	02 04	02 04	-अविपेक्षी अवरक्त (NDIR) स्पैक्ट्रम मापन
8	अमोनिया (NH_3) $\mu g/m^3$	वार्षिक* 24 घंटे**	100 400	100 400	-रासायनिक संदीप्ती -इण्डोफिनॉल ब्ल्यू पद्धति
9	बैन्जीन (C_6H_6) $\mu g/m^3$	वार्षिक*	05	05	- गैस क्रोमेटोग्राफी आधारित सतत् विश्लेषक -अधिशोषण तथा निशोषण के बाद गैस क्रोमेटोग्राफी
10	बैन्जो (ए) पाईरीन (BaP) केवल विविक्त कण, ng/m^3	वार्षिक*	01	01	-विलायक निष्कर्षण के बाद HPLC/GC द्वारा विश्लेषण
11	आर्सेनिक (As) ng/m^3	वार्षिक*	06	06	-असंवितरक अवरक्त स्पैक्ट्रामिती ई.पी.एम. 2000 या समरूप फिल्टर पेपर का प्रयोग करके ICP/AAS पद्धति
12	निकिल (Ni) ng/m^3	वार्षिक*	20	20	ई.पी.एम. 2000 या समरूप फिल्टर पेपर का प्रयोग करके ICP/AAS पद्धति

* वर्ष में एक समान अंतरालों पर सप्ताह में दो बार प्रति 24 घंटे तक किसी एक स्थान विशेष पर लिये गये न्यूनतम 104 मापों का वार्षिक अंकगणीतीय औसत ।

** वर्ष में 98 प्रतिशत समय पर 24 घंटे या 8 घंटे या 1 घंटा के मानीटर मापमान, जो लागू हो , अनुपालन कये जाएंगे । दो प्रतिशत समय पर यह मापमान अधिक हो सकता है, किन्तु क्रमिक दो मानीटर करने के दिनों पर नहीं ।

टिप्पणी:

1. जब कभी और जहां भी किसी अपने-अपने प्रवर्ग के लिये दो क्रमिक प्रबोधन दिनों पर मापित मूल्य, ऊपर विनिर्दिष्ट सीमा से अधिक हो तो इसे नियमित या निरंतर प्रबोधन तथा अतिरिक्त अन्वेषण करवाने के लिये पर्याप्त कारण समझा जायेगा ।

संत प्रसाद गौतम, अध्यक्ष

[विज्ञापन-III/4/184/09/असा.]

टिप्पणी: राष्ट्रीय परिवेशी वायु गुणवत्ता मानक संबंधी अधिसूचनाएँ, केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा भारत के राजपत्र आसाधरण में अधिसूचना संख्या का.आ. 384 (ई), दिनांक 11 अप्रैल, 1994 एवं का. आ. 935 (ई), दिनांक 14 अक्टूबर, 1998 द्वारा प्रकाशित की गयी थी ।

NATIONAL AMBIENT AIR QUALITY STANDARDS
CENTRAL POLLUTION CONTROL BOARD
NOTIFICATION

New Delhi, the 18th November, 2009

No. B-29016/20/90/PCI-I.—In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in supersession of the Notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect, namely:-

NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m³	Annual* 24 hours**	50 80	20 80	- Improved West and Gaeke -Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m³	Annual* 24 hours**	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m³	Annual* 24 hours**	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m³	Annual* 24 hours**	40 60	40 60	- Gravimetric - TOEM - Beta attenuation
5	Ozone (O_3) µg/m³	8 hours** 1 hour**	100 180	100 180	- UV photometric - Chemilminescence - Chemical Method
6	Lead (Pb) µg/m³	Annual* 24 hours**	0.50 1.0	0.50 1.0	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m³	8 hours** 1 hour**	02 04	02 04	- Non Dispersive Infra Red (NDIR) spectroscopy
8	Ammonia (NH_3) µg/m³	Annual* 24 hours**	100 400	100 400	-Chemiluminescence -Indophenol blue method

(1)	(2)	(3)	(4)	(5)	(6)
9	Benzene (C_6H_6) µg/m^3	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m^3	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m^3	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note. — Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

SANT PRASAD GAUTAM, Chairman
[ADVT-III/4/184/09/Exty.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India, Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998.

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ANNEXURE-XIII:
QCI ACCREDITATION LETTER

National Accreditation Board
for Education and Training

NABET

November 29, 2010

Mr. Sanjeev Sharma
General Manager
Mantec Consultants Pvt. Ltd.
D-36, Sec-6,
Noida, U. P - 201301

Dear Sir,

QCI – NABET Scheme for Accreditation of EIA Consultant Organization

This is with reference to your application for QCI – NABET Accreditation as EIA Consultant Organization.

We are pleased to inform you that based on Document & Office Assessment, the Accreditation Committee has recommended the accreditation of **Mantec Consultants Pvt. Ltd.** as per the scope given in Annexure I (A & B).

Please confirm the correctness of spellings of the names of the experts mentioned in Annexure I B. The detailed terms and conditions are mentioned in Annexure II. You are also advised to check the QCI website for the Minutes of the Accreditation Committee Meeting held on October 12, 2010, for observations related to your application or any decisions with respect to Scheme/ assessment process and take necessary action for compliance.

The accreditation of your organization will be for three year period starting September 28, 2010. The annual renewal of the accreditation will be confirmed after surveillance assessment every year. Surveillance assessments will be conducted to ensure compliance with NABET Scheme and the details mentioned in your Quality Manual.

May we request you for an early payment of the annual fees and your confirmation of acceptance of the terms and conditions attached. This will enable us to issue you the requisite accreditation letter & certificate which will be valid for one year duration.

We thank you for your esteemed support in making this scheme successful and for your participation in this national cause.

Thanks and best regards,

Yours sincerely,

Vipin Sahni
Director

... Building, 2nd Floor, Bahadur Shah Zafar Marg, New Delhi - 110 002, India.

Name of the Consultant: Mantec Consultants Pvt. Ltd.

D-36, Sec-6,
Noida, U. P - 201301

Sectors Approved – 7 Nos.

Sl. No.	Sector No.	Name of Sector	Category A/B
1	1	Mining of minerals (opencast only)	A
2	3	River Valley, Hydel, drainage and Irrigation Projects	B
3	4	Thermal power plants	A
4	10	Petroleum refining industry	A
5	16	Chemical fertilizers	A
6	33	Jetties only	A
7	34	Highways, railways, transport terminals, mass rapid transport systems	A

Total = 7 Sectors*

**Sectors allocated to Individual EIA Coordinators are mentioned in Annexure I-B*

Vipin Sahni
Director
NABET

November 29, 2013

NABET/EIA/024/RA-002
Dr. Vivek N. Singh
The Deputy General Manager (Env.)
Mantec Consultants (P) Ltd.
Environment Management Division,
D-36, Sector 06,
Noida-201301

Dear Dr. Singh,

Sub: Validity of Accreditation as EIA Consultant Organization – Mantec Consultants (P) Ltd.

This has reference to the provisional accreditation given to your organization and its validity under QCI-NABET EIA Scheme.

As you are aware, the process of re-accreditation has already been initiated and application form for same has been sent to you by NABET vide email dated August 21, 2013. While the re-accreditation application is processed, the provisional accreditation granted to Mantec Consultants (P) Ltd., Noida is hereby extended by 6 months i.e March 28, 2014 or till re-accreditation whichever is earlier.

The above extension is subject to the submission of required information/ documents related to re-accreditation to NABET on time. You are requested not to use this letter after expiry of the stated date.

With best regards,

(Vipin Sahni)
C.E.O.