

ENVIRONMENTAL IMPACT ASSESSMENT

STUDY REPORT FOR PROPOSED COGENERATION POWER PLANT (GT-IV) AND ENHANCED REACTIVE THERMAL OXIDISER (ERTO) UNIT AT URAN, MAHARASHTRA



OIL AND NATURAL GAS CORPORATION (ONGC)



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INDIA LIMITED**
(भारत सरकार का उपक्रम) (A Govt. of India Undertaking)

ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR PROPOSED GT-IV AND ERTO UNIT AT ONGC- URAN

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Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by

TOR COMPLIANCE STATEMENT

S. No.	Statement	Compliance
A. STANDARD TERMS OF REFERENCE		
1.	Executive summary of the project	Included in EIA report.
2.	Introduction i. Details of the EIA Consultant including NABET accreditation ii. Information about the project proponent iii. Importance and benefits of the project	Details are given in section 1.1 of Chapter-1. Details are given in section 1.2 of Chapter-1. Details are given in section 1.3.3 of Chapter-1.
3.	Public Hearing/consultation to be conducted by the SPCB as per the provisions of the EIA Notification, 2006.	Public Hearing will be conducted.
4.	Project Description	
	Cost of project and time of completion.	Details of cost of project are given in section 2.0 of Chapter-2. It is envisaged that the construction of proposed facilities will be completed in 28 months from EC.
	Products with capacities for the proposed project.	Details of products including capacities are given in section 2.3 of Chapter-2.
	If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.	Not Applicable.
	List of raw materials required and their source along with mode of transportation.	Details of feed stock are given in section 2.3 of Chapter-2.
	Other chemicals and materials required with quantities and storage capacities	Details of chemicals are given in section 2.5.4 of Chapter-2.
	Details of Emission, effluents, hazardous waste generation and their management.	Details of Emission, effluents, hazardous waste generation and their management from the proposed project is given in section 2.5.3, 2.4.2.3, 2.4.2.4 of Chapter-2.
	Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract).	Details of utilities consumption due to proposed project is given in Chapter-2. Water balance diagram is given in page 33 of Chapter-2. Man-power requirement is given in section no. 2.4.1 in Chapter-2.
	Process description along with major equipments and machineries, process flow sheet (quantities) from raw material to products to be provided.	Process flow diagram, process description and other details are given in Section 2.2 of Chapter – 2.
	Hazard identification and details of proposed safety systems.	Summary of risk assessment for the proposed facilities is given in section 7.2 of Chapter- Complete details of risk assessment study are given in Annexure VIII.
	Expansion/modernization proposals: Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular	Not Applicable.

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	dated 30 th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing I existing operation of the project from SPCB shall be attached with the EIA-EMP report.	
	In case the existing project has not obtained environmental clearance.	Not applicable
5.	Site Details	
	Location of the project site covering village, Taluka/Tehsil, District and State.	Details are given in section 1.3.2 of Chapter-1.
	Justification for selecting the site, whether other sites were considered.	Not applicable
	A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places).	Location of project is given in Figure 1.2, Chapter-1
	Details w.r.t. option analysis for selection of site.	Not applicable
	Co-ordinates (lat-long) of all four corners of the site.	Details are given in section 1.3.2 of Chapter-1.
	Google map-Earth downloaded of the project site.	Site superimposed on satellite imagery is shown in Figure 1.1 of Chapter-1.
	Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.	Overall plot plan of proposed project is shown in Figure 2.1 of Chapter-2.
	Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.	Existing green belt marked on overall plot plan is given as Figure 2.1 of Chapter-2.
	Landuse break-up of total land of the project site (identified and acquired), government/private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area).	Thematic land use map are given in Figure 3.1 in Chapter-3.
	A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area	List of industries are given in section 1.3.4 Chapter-1.
	Geological features and Geo-hydrological status of the study area shall be included.	Thematic map of geological features is given in Chapter-3.
	Details of Drainage of the project upto 5km radius of study area. If the site is within 1km radius of any major	Thematic map of drainage in study zone is given in Chapter-3.

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	river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided (mega green field projects).	
	Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.	Proposed units are coming inside existing ONGC-Uran plant.
	R&R details in respect of land in line with state Government policy.	Not applicable
6.	Forest and wildlife related issues (if applicable):	Not applicable
7.	Environmental Status	
	Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.	Meteorological data was collected from Refinery during March-May, 2017. Details are given in section 3.2 of Chapter-3.
	AAQ data (except monsoon) at 8 locations for PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.	Ambient air quality is measured for PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO and other parameters were monitored at eight locations during March-May, 2017 and September-November, 2018. Details are given in Chapter-3.
	Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQPM Notification of Nov. 2009 along with – min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.	Ambient air quality Data is given in section 3.6 of Chapter-3.
	Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEFCC guidelines.	Surface water quality Data is given in section 3.9 of Chapter-3.
	Whether the site falls near to polluted stretch of river identified by the CPCB/MoEFCC, if yes give details.	Not applicable
	Ground water monitoring at minimum at 8 locations shall be included.	Ground water quality Data is given in section 3.9 of Chapter-3.
	Noise levels monitoring at 8 locations within the study area.	Noise quality Data is given in section 3.7 of Chapter-3.
	Soil Characteristic as per CPCB guidelines.	Soil quality Data is given in section 3.10 of Chapter-3.
	Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.	Traffic study Data is given in section 3.8 of Chapter-3.

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	Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.	Detailed description of flora and fauna is given in section 3.11 of Chapter-3. No rare, endemic and endangered species is found within study area.
	Socio-economic status of the study area.	Detailed socio-economic status of the study area as per Census 2011 is given in section 3.12 of Chapter-3.
8.	Impact and Environment Management Plan	
	Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features.	Modelling has been carried out using AERMOD and details of modelling are given in section 4.3.2 of Chapter-4.
	In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ.	Not applicable
	Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed.	Modelling has been carried out using AERMOD considering cumulative impact of all sources. Details of modelling are given in section 4.3.2 of Chapter-4.
	Details of the model used and the input data used for modelling shall also be provided.	Details of modelling are given in section 4.3.2 of Chapter-4.
	The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.	Details of modelling are given in section 4.3.2 of Chapter-4.
	Water Quality modelling – in case of discharge in water body.	Not applicable
	Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided.	No new transport of raw materials/end products is envisaged under proposed project.
	A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included.	There will be no wastewater generation from GT-IV unit. The liquid effluent (quantity <100 m ³ per day) from ERTU unit, mainly brine solution of Sodium Sulfite (Na ₂ SO ₃), shall be diluted with existing treated water (~ 3000m ³ per day) from effluent treatment plant and finally discharged into sea (complying MPCB standards). Sodium Sulfite (Na ₂ SO ₃) being white colored salt solution and all parameters like BOD, TSS, PH shall be maintained as per MPCB norms, before discharging to sea,
	Complete scheme of effluent treatment.	Details of wastewater generation and recycling are given in Chapter-2.
	Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.	Details of wastewater generation and recycling are given in Chapter-2.

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	Details of stack emission and action plan for control of emissions to meet standards.	Details are given in section 4.3.2 of Chapter-4 and section 5.4.1.2 of Chapter-5.
	Measures for fugitive emission control.	Fugitive emissions not envisaged.
	Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.	Details of various types of waste generation from proposed project is given in section 4.6 of Chapter-4.
	Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.	Not applicable.
	Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.	Details are given in section 6.4 of Chapter-6.
	Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.	Details are given in section 6.2.2 of Chapter-6.
	Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.	Break up of capital and recurring cost/annum for environmental pollution control measures is given in section 6.9 of Chapter-6.
	Action plan for post-project environmental monitoring shall be submitted.	Given in section 6.6 of Chapter-6.
	Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.	Summary of risk assessment for the proposed facilities is given in section 7.2 of Chapter-7. Complete details are given in Annexure V.
9.	Occupational health	
	Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.	Given in section 6.7 of Chapter-6.

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	Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.	Given in section 6.7 of Chapter-6.
	Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,	Not applicable.
	Annual report of health status of workers with special reference to Occupational Health and Safety.	Not applicable.
10.	Corporate Environment Policy	
	Does the company have a well laid down environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	Yes, HSE policy of the company is given in section nos. 6.5 & 6.6 in Chapter-6.
	Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.	Yes.
	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.	HSE organogram structure is given in Annexure Chapter-6.
	Does the company have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report.	Details of existing environmental management reporting procedures are given in Chapter-6.
11.	Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.	No labour camps are envisaged during construction phase of the proposed project.

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12.	Enterprise Social Commitment (ESC)	
	Adequate funds (at least 2.5 % of the project cost) shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon	As per prevailing corporate social policy adequate funds shall be earmarked for social well being. Details are given in Section 6.8.5, Chapter-6.
13.	Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.	Not applicable
B. SPECIFIC TERMS OF REFERENCE		
1.	Details on requirement of raw material (naphtha/gas feedstock), its source of supply and storage at the plant.	Feed for GT-IV: Natural Gas Feed for EROTO: acid gas generated from the GSU. Storage and other details are given in Chapter-2 of EIA report.
2.	Complete process flow diagram for all products with material balance.	Process flow diagram of ONGC-Uran plant and EROTO unit have been provided in Chapter-2 along with material balance.
3.	Brief description of equipments for various process (cracker, separation, polymerization etc)	New cogeneration plant will have an additional gas turbine (Cap. 20 MW) and heat recovery steam generator (cap. 60 TPH) within the existing plant. The Uran Plant has a gas sweetening unit which removes H ₂ S from the natural gas recovered at the plant. Presently this H ₂ S is discharged through a tall stack. ONGC is installing an Enhanced Reactive Thermal Oxidiser (ERTO) system. Detailed process description of GT-IV and EROTO have been provided in Chapter-2.
4.	Details of proposed source-specific pollution control schemes and equipments to meet the national standards.	Details of source specific pollution control measures have been given in Chapter-6 (EMP) for air, water, land, noise, biological, socioeconomic environments to meet the statutory regulations.
5.	Details on VOC emission control system from vents, stacks, fugitive emissions and flare management, etc.	The proposed project is installation of Gus turbine and EROTO to treat acid gas generated from GSU. Hence, this point is not applicable. However, ONGC-Uran plant is equipped with proper system to control VOC emission.
6.	Details on proposed LDAR protocol.	Adequate LDAR programme is in place which will be extended for the proposed project. Details has

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		been provided in Chapter-7 of EIA report.
7.	Ambient air quality should include hydrocarbon (methane and non methane), VOC and VCM (if applicable).	Ambient air quality including HC and VOC are provided in Chapter-3 of EIA report.
8.	Action plan to meet the standard prescribed under EPA for petrochemical complex.	ONGC-Uran plant is complying with all the standards as prescribed.
9.	Risk Assessment & Disaster Management Plan <ul style="list-style-type: none"> • Identification of hazards • Consequence Analysis • Measures for mitigation of risk. 	Detailed RRA study for GT-IV and ERTO has been provided as Annexure-V.

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Annexure No.	Annexure Title
I.	APPROVED TERMS OF REFERENCE
II.	COMPLIANCE TO ALL PREVIOUS ECs
III.	CERTIFIED LETTER FROM MoEFCC REGIONAL OFFICE ON PREVIOUS EC COMPLIANCE
IV.	PLOT PLAN DRAWING OF GT-IV & ERTU UNIT
V.	RAPID RISK ANALYSIS REPORT

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

The Executive Summary covers the following topics in brief:

1. Project Description
2. Description of Environment
3. Anticipated Environmental Impacts and Mitigation measures
4. Environmental Monitoring Program
5. Environment Management Plan
6. Additional studies
7. Project Benefits

1.1 PROJECT DESCRIPTION

ONGC is the owner and operator of the Uran oil and gas processing plant. Maharatna ONGC is the largest producer of crude oil and natural gas in India, contributing around 70% of Indian domestic production. The crude oil is the raw material used by downstream companies like IOC, BPCL, HPCL to produce petroleum products like Petrol, Diesel, Kerosene, Naphtha, LPG. The plant processes 20 million tonnes per year (Mt/yr) of crude oil and 16 million standard cubic metres per day (MMSCMD) of natural gas. Crude oil received at Uran is finally stabilized at the CSU plant and water is separated out by dehydrator before sending to storage tanks. From Natural Gas value added products viz., 0.625 Mt/yr of LPG, 0.625 Mt/yr of C2-C3 and 0.33 Mt/yr of naphtha are produced.

Part of the natural gas produced at the plant is utilized as fuel in a cogeneration power plant comprising of three gas turbines (total cap. 58.8 MW) and heat recovery steam generators (total cap. 240 TPH) and 90 TPH gas fired boiler to generate power and steam to meet the plant's own requirements. In order to process additional C-series gas from offshore, additional gas processing facilities such as LPG-III, GSU-III, CFU-III & CHU-IV were installed in 2013. Power requirement is approximately 20 MW (Continuous) and 60 TPH Steam from HRSG.

The proposed project envisages installation of an additional gas turbine (Cap. 20 MW) and heat recovery steam generator (cap. 60 TPH) within the existing plant. The feed gas for the new gas turbine will be natural gas like the existing ones.

The Uran Plant has a gas sweetening unit which removes H₂S from the natural gas recovered at the plant. Presently this H₂S is discharged through a tall stack. ONGC is installing an Enhanced Reactive Thermal Oxidiser (ERTO) system, the first of its kind in the country which will virtually eliminate H₂S from the plant. The H₂S will be oxidized to SO₂. The combustion gases will be scrubbed with sodium hydroxide solution in a wet scrubber. The scrub liquid, containing mainly sodium sulfite, shall be diluted with treated effluent from ETP and finally discharged into the sea through a diffuser.

The proposed project is coming with existing ONGC-Uran plant area. The total ONGC-Uran plant area is 112 ha. Proposed area to be developed for proposed additional Cogeneration plant and ERTO is 60 ha which is within the plant boundary.

The estimated capital cost for the proposed project is Rs. 26895 Lakhs. The proposed project is expected to be mechanically completed in 28 months from the Zero date (After receipt of Environmental Clearance).

As per the Ministry of Environment and Forests (MoEF), New Delhi, any new project or modernization or expansion project need to have an Environmental Clearance from MoEFCC. In accordance with this, ONGC has decided to conduct Environmental Impact Assessment (EIA) study. Based on the TOR, three months (12 weeks) non-monsoon baseline data of March- May, 2017 was collected and analyzed. Ambient air also monitored during September-November, 2018 in eight locations.

M/s ONGC has entrusted M/s Engineers India Limited (EIL) to carry out environment impact assessment study and preparation of environmental management plan for various environmental components of the proposed project. EIL is an accredited consultant for carrying out EIA studies by Quality Council of India Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics) [Sl. no. 5 (c), Category A as per 2006 EIA Notification].

1.2 Existing Environmental Status

Existing baseline survey carried out during March to May, 2017 representing Summer season based on TOR in the 10 km radius study area. Sampling and analysis for ambient air quality, noise levels, water quality and soil quality has been carried out by the Environmental Engineering Laboratory of MECON Limited. The description of the existing environmental status of the study area is summarized here.

1.2.1 Air Environment

PM₁₀, PM_{2.5}, SO₂, NO_x, HC (Methane & Non Methane) CO, Benzene at Eight (08) different locations were collected. A summary of the same is given in Table 1.

Table 1: Summary of Baseline data of AAQs

Location	Baseline value (98 th percentile)			
	PM10	PM2.5	SO _x	NO _x
AAQ1- Nagaon	61.8	31.5	7.3	27.3
AAQ2- Pirwadi	60.5	31.3	6.9	27.7
AAQ3- Daurnagar	60.9	30.4	7.1	28.2
AAQ4- Karanja	62.7	34.1	7.4	31.5
AAQ5- ONGC plant gate	63.2	34.4	9.4	33.5
AAQ6- Kegaon	61.0	31.6	7.4	28.7
AAQ7- Funde	61.4	30.7	8.1	28.7
AAQ8- Mora	62.3	31.8	8.8	28.8
NAAQS Standards	100 µg/m ³	60 µg/m ³	80 µg/m ³	80 µg/m ³

All parameters were found well within limits prescribed by NAAQS 2009 for all eight locations.

1.2.2 Water Environment:

Sources of water in the study area are surface water in sea / creeks and ground water. Water samples have been collected from ten (10) locations (05 ground water and 05 surface water sample locations). The following can be summarized from the results:

- ❖ All the ground water samples are “Hard”. At four of the five locations, Hardness exceeds the “Acceptable Limits” but is within the “Permissible Limits”. At the 5th location (Karanja) even the Permissible Limits has been exceeded.
- ❖ At four of the five locations, Alkalinity exceeds the “Acceptable Limits” but is within the “Permissible Limits”. At the 5th location (Karanja) even the Permissible Limits has been exceeded.
- ❖ Hardness and Alkalinity of water are due to presence of calcium and magnesium salts and this is reflected in the results. Ground water from Karanja contains excess of calcium and magnesium.
- ❖ At three of the five locations, Dissolved Solids exceeds the “Acceptable Limits” but is within the “Permissible Limits”. At one location (Nagaon), the Dissolved Solids content is within the Acceptable Limit but at the 5th location (Karanja) even the Permissible Limits has been exceeded.
- ❖ At Karanja, sea water has intruded into ground water in a major way as indicated by the very high chloride content (which is also reflected in the excessive dissolved solids content).
- ❖ Ground water from Karanja is totally unfit for drinking. At the other locations, the ground water may be used for drinking in absence of any other source.

Vimla Talao is located in a public park in Uran town, whereas Kegaon lake is on the outskirts of the town. Both these fresh water bodies are located close to the coast and consequently chloride and dissolved solid levels are slightly elevated. Both water bodies appeared to be eutrophic as indicated by the greenish colour of the water. High coliform content also indicates sewage pollution.

The water of Karanja Creek meets the quality criteria specified for “Industrial Cooling, Recreation (non-contact) and aesthetics” (SW III). It would have been suitable for “Bathing, Contact Water Sports and Commercial Fishing” (SW II) except for slightly higher Faecal Coliform Content. It may be noted that there are several settlements on the banks of this creek and it is likely sewage discharge from these settlements have contributed to the faecal coliform content of Karanja Creek.

Sea water off Pirwadi and off Kegaon is suitable for “Bathing, Contact Water Sports and Commercial Fishing” (SW II). However it was noted, that although no oil slick was visible on the surface at both these locations, there was some oil and grease at these locations (17mg/l off Pirwadi and 11mg/l off Kegaon). Dharmatar Creek, Karanja Creek as well as Thane Creek receive lots of urban run-offs and industrial effluents. These have contributed oil & grease to the water.

1.2.3 Noise Environment:

Noise monitoring has been carried at the eight locations where ambient air quality had been monitored. A summary of the same is given in Table 2. The results indicate that day time noise levels at all the residential areas, day-time as well night time noise levels were within the norms for “Residential Areas”. At the Plant Main Gate, the noise levels were within the norms for “Industrial Areas”.

Table-2: Summarised Results of Ambient Noise Monitoring

Stn. No.	Location	Noise Standard	Results [dB (A)]					
			Day (0600-2200 hr.)			Night (2200-0600 hr.)		
			Max.	Min.	Avg.	Max.	Min.	Avg.
N1	Village Nagaon	Residential Area (Day:55; Night:45)	54.6	39.2	48.1	41.5	36.2	38.7
N2	Village Pirwadi	Residential Area (Day:55; Night:45)	57.4	44.8	53.0	45.6	40.9	43.6
N3	Village Daurnagar	Residential Area (Day:55; Night:45)	56.3	43.7	51.9	44.2	37.4	40.9
N4	Village Karanja	Residential Area (Day:55; Night:45)	52.8	40.7	46.4	44.8	38.2	41.2
N5	ONGC Plant Main Gate	Industrial Area (Day:75; Night:70)	63.6	47.4	58.4	52.4	46.1	49.5
N6	Village Kegaon	Residential Area (Day:55; Night:45)	53.0	40.9	47.4	41.9	36.5	38.7
N7	Village Funde	Residential Area (Day:55; Night:45)	55.6	40.7	52.7	44.1	36.9	40.4
N8	Village Mora	Residential Area (Day:55; Night:45)	49.7	39.2	45.7	42.9	37.4	39.6

1.2.4 Soil Environment:

To assess the quality of soil in study area, soil samples were collected from four locations around the plant.

In the study area the soil pH is slightly alkaline ($7.8 < \text{pH} < 7.2$). Electrical conductivity (EC) for the collected soil samples ranged from 80 to 329s/cm. Phosphorus and Nitrogen are limiting nutrients, especially phosphorus. In the tested soil samples, availability of phosphorus is low in most samples. Availability of nitrogen was low in one sample (fallow land from Nagaon) but medium in the other three samples. Organic carbon is high in all four samples. In all four tested soil samples calcium constitutes bulk of the exchangeable cations followed by magnesium whereas proportion of exchangeable sodium and potassium were low. It can be seen that in all of the four samples copper as well as iron levels are higher than the critical limits.

1.2.5 Biological Environment:

The study area is located on the eastern shore of the Arabian Sea. About half the study area is covered by the sea. The terrestrial part of the study area comprises of rural & urban settlements, industrial lands, waste lands, mangroves, surface water bodies, marshy areas, forests, agricultural land etc. The landward part of study area is partly urban and partly rural. The rural areas comprises of forests (only on the hill), tidal creeks & marshy areas, agricultural land, waste / barren lands and rural settlements.

At the site of the proposed project, the vegetation comprises of some coconut palms and bottle palms which form part of the plant's plantation areas, some *Zizyphus* trees and saplings of peepal (*Ficus religiosa*), banyan (*Ficus bengalensis*) other figs (*Ficus spp.*), *Tridax procumbens* and some grasses are found growing on the road side.

The terrestrial part of study area comprises of urban as well as rural areas. Most of the area is plain. However there a massive forested escarpment, Dronagiri Hill on the eastern side of the plant. The lower slopes of Dronagiri Hill and the top of the ridge are forested. There is stretch of near vertical rock cliff just below the top of the ridge. Another ~2 km long hill extending in the north-east–south-west direction is located ~2.5 km north of the project site. The vegetation on this hill is sparse.

In most of the study area, due to lack of suitable habitat diversity of animals is low. The forest on Dronagiri Hill is good wildlife habitat but it has no permanent large surface water body and moreover it is an isolated patch and surrounded by human settlements and industries.

1.2.6 Socio-economic conditions:

The socioeconomic aspects of the study area are assessed using Primary and Secondary data. Secondary data was also collected from published sources like, census data of 2011. Total population of the study area as recorded in 2011 census is 1,05,444. The sex ratio in the study area (915.87 females per 1000 males) is lower than the national average (943). SC and ST categories constitute ~4.3% and ~5.2% of the population respectively. Literacy rate is ~75.6%. Working population constitute 39.24% of the total population. Main and marginal workers constitute 30.67% and 8.57% of total population respectively. It may be noted that of that ~84.3% of the main workers are classified as "Other Main Workers" i.e. they are mostly engaged in industry, services, commerce and other allied activities. The few thousand people engaged in agricultural activities work some of the plantations north of the plant and crop lands come from the eastern fringes of the study area.

1.3 ANTICIPATED ENVIRONMENTAL IMPACTS

The environmental impacts associated with the proposed project during construction and operational phases of the project on various environmental components have been identified and are given in **Table-3**.

Table-3: Impact Identification Matrix

Activities	Physical				Biological		Socio-economic	
	Ambient air quality	Ground / surface water (quantity / quality)	Ambient noise	Land (land use, topography & drainage, soil)	Flora	Fauna	Livelihood & occupation	Infrastructure
CONSTRUCTION PHASE								
Site preparation	*		*	*	*	*	*	

Civil works	*		*			*		
Heavy equipment operations			*					
Disposal of construction wastes				*				
Generation/disposal of sewerage		*		*				
Transportation of materials	*		*					
OPERATION PHASE								
Commissioning of Process units, utilities and offsite	*	*	*					
Product handling and storage	*							
Emissions & Waste management – Air, liquid and solid waste	*	*		*				

Impacts have been assessed considering spatial, temporal, intensity and vulnerability scales and its overall significance value is given in Table-4.

Table-4: Impact Assessment Summary

Environmental component		Construction	Operation
Air		Low	Low
Water	Consumption of Raw Water	Low	Medium
	Generation of Effluent	Low	Low
Land	Land use & Topography	Low	-
	Soil Quality	Low	Low
Noise		Low	Low
Biological		Low	Low
Socio-Economic		Low	Low

1.4 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

1.4.1 AIR ENVIRONMENT

Construction Phase

Impacts (Significance - Low)

- Dust will be generated from earth-moving, grading and civil works, and movement of vehicles on unpaved roads.
- PM, CO, NO_x, & SO₂ will be generated from operation of diesel sets and diesel engines of machineries and vehicles.

Mitigation Measures

- Ensuring preventive maintenance of vehicles and equipment.
- Ensuring vehicles with valid Pollution under Control certificates are used.
- Implementing dust control activities such as water sprinkling on unpaved sites.
- Controlling vehicle speed on site

Operation Phase

Impacts (Significance - Low)

The resultant SO₂ with ambient air quality concentration is estimated as 10.84 µg/m³ which is well within the standard limits for 24 hourly average for industrial area i.e. 80 µg/m³.

The resultant NO_x ambient air quality concentration is estimated as 35.02 µg/m³ which is less than which is well within the standard limits for 24 hourly average for industrial area i.e. 80 µg/m³.

Mitigation measures

- Ensuring preventive maintenance of equipment.
- Regular monitoring of air polluting concentrations.

1.4.2 WATER ENVIRONMENT

Construction Phase

Impacts (Significance – Low)

- Raw water for construction phase will be met from existing water source i.e. by Maharashtra Industrial Development Corporation (MIDC). The peak water requirement during construction will be upto 50 KLD.
- The effluent streams will be generated regularly that will comprise of Sewage, grey water from site area and washing water for vehicle and equipment maintenance area.

Mitigation Measures

- Monitoring water usage at work sites to prevent wastage.

Operation Phase

Impacts (Significance – Medium)

- For ERTO unit additional ~220 m³/day of raw water is required which will be met from existing sources (MIDC). However, the raw water demand of the complex shall be well within the consent limit of 16500 m³/day.
- The liquid effluent (quantity <100 m³ per day), mainly brine solution of Sodium Sulfite (Na₂SO₃) shall be generated from new ERTO unit. The effluent shall be diluted with existing treated water (~ 3000 m³ per day) from effluent treatment plant and finally discharged into sea (complying MPCB standards).

Mitigation Measures

- All effluents will be treated and recycled.

1.4.3 NOISE ENVIRONMENT

Construction Phase

Impacts (Significance – Low)

- Noise generation due to operation of heavy equipment and machinery, movement of heavy vehicles in site preparation and civil works.

Mitigation Measures

- Ensuring preventive maintenance of equipments and vehicles.

Operation Phase

Impacts (Significance – Low)

Noise level measurements were carried out in day and night times at numerous locations around the existing operating units within the refinery. No additional impact is envisaged.

Mitigation Measures

- Avoiding continuous (more than 8 hrs) exposure of workers to high noise areas.
- Provision of ear muffs at the high noise areas
- Ensuring preventive maintenance of equipment.

1.4.4 LAND ENVIRONMENT

Construction Phase

Impacts (Significance – Low)

- Generation of debris/construction material, but being the modifications limited to existing area, the generation of such waste shall be minimal.

Mitigation Measures

- Restricting all construction activities inside the project boundary.
- Ensuring any material resulting from clearing and grading should not be deposited on approach roads, streams or ditches, which may hinder the passage and/or natural water drainage.
- Developing project specific waste management plan and hazardous material handling plan for the construction phase.

Operation Phase

Impacts (Significance – Low)

- Solid waste in the form of ash from lignin (which is used as fuel in boiler).

Mitigation Measures

- The solid waste that is produced during operation phase will be either sold as manure for agricultural fields or to brick and cement industries.

1.4.5 BIOLOGICAL ENVIRONMENT

Construction Phase

Impacts (Significance –Low)

- The impact of construction activities on fauna will be insignificant due to proposed construction activities are within proposed plant.

Mitigation Measures:

- Closing of trenches as soon as possible of construction.
- Prevent littering of work sites with wastes, especially plastic and hazardous waste.
- Training of drivers to maintain speed limits.
- Development of green belt during construction phase.

Operation Phase

Impacts (Significance – Low)

- The impacts due to proposed project activities during operation phase shall be insignificant due to minimal additional air emissions.

Mitigation measures

- Maintain the greenbelt already developed

1.4.6 SOCIO-ECONOMIC ENVIRONMENT

Construction Phase

Impacts (Significance – Low)

- Generation of temporary employment of very substantial number of personnel. The average temporary manpower requirement is 50 people during first year and 100 people during second year & third year.
- Transport requirements will arise during the construction phase due to the movement of both the personnel and materials.
- An impact on basic necessities like shelter, food, water, sanitation and medical facilities for the temporary workers and truck drivers.
- The majority of skilled and unskilled laborers are available in the impact area itself, the incremental effect on housing during the construction phase will be minimal.

Mitigation measures

- Conducting awareness programs for workers.
- Determining safe, legal load limits of all bridges and roads that will be used by heavy vehicles and machinery.
- Determining allowable traffic patterns in the affected area throughout the work week will be made based on community use, include a consideration of the large turning.
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Preventing use of drugs and alcohol in project-sites.
- Preventing possession of firearms by project-personnel, except those responsible for security.

Operation Phase

Impacts (Significance – Low)

- Employment generation, effects on transport and other basic infrastructure.
- Transport requirements will arise due to the movement of both the personnel and materials.
- Employment of approximately 10 persons directly and around 30 persons indirectly are envisaged during operation phase.

Mitigation measures

- Extending reach of CSR/CER Program.
- Monitoring speed and route of project-related vehicles.

1.5 ENVIRONMENTAL MANAGEMENT PLAN AND MONITORING PROGRAM

Budget has been estimated for implementation of environmental management plan during construction and operational phases and is given in Table 5 & 6 respectively.

Table-5: BUDGET OF ENVIRONMENTAL MANAGEMENT PLAN (Capital Cost)

Sl. No.	Activity	Budget (Rupees in Lakhs)
1.0	Air Environment	
1.1	Plantation Activities (Trees and Shrubs)	80.0
1.2	Air quality monitoring	60.0
2.0	Noise Environment	
2.1	Additional Plantation Activities	Included in 1.1

2.2	Audiometric tests	2.0
3.0	Water Environment	
3.1	Rain water Harvesting pits	20.0
4.0	Land Environment	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Solid waste management	4.0
5.0	Biological Environment	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Capital Cost)	166.0

Table-6: BUDGET OF ENVIRONMENTAL MANAGEMENT PLAN (Recurring Cost per Annum)

Sl. No.	Activity	Budget (Rupees in Lakhs)
1.0	Air Environment	
1.1	Additional Plantation Activities (Trees and Shrubs)	20.0
1.2	Air quality monitoring	20.0
2.0	Noise Environment	
2.1	Additional Plantation Activities	Included in 1.1
2.2	Audiometric tests	1.0
3.0	Water Environment	
3.1	Rain water Harvesting pits	5.0
3.2	Additional storage tank for treated wastewater and distribution network	5.0
4.0	Land Environment	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Solid waste management	4.0
5.0	Biological Environment	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Recurring Cost per Annum)	55.0

1.6 ADDITIONAL STUDIES

1.6.1 RAPID RISK ASSESSMENT

RRA study evaluates the consequences of potential failure scenarios, assess extent of damages, based on damage criteria's and suggest suitable measures for mitigating the Hazard. The summary of major observations & recommendations of RRA study for proposed GT-IV and ERTO is recorded below:

For GT-IV

Both high & low frequency flammable scenarios are modeled for hydrocarbon handling section of new proposed GT-IV Package.

- It is observed that the consequence outcomes (radiation & explosion) in the event of leak scenarios in KOD inlet section (5 mm, 10 mm, 20 mm & 50 mm), NG Steam heater outlet (10 mm & 20 mm), Fine Filter Separator Outlet line (10 mm & 20 mm) may affect & damage the nearby equipment's such as OWS pump station,

pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4 and condensate tank area.

Hence, it is recommended to locate the hydrocarbon & fire detectors at strategic locations near to these equipment's and provide adequate passive fire protection for the supports of affected equipment's / pipe racks. It is also recommended to ensure adequate fire-fighting provisions and remote isolation provisions for NG handling equipment / piping.

- Consequence outcomes (radiation & explosion) are also modelled for Fine Filter Separator Outlet line (10 mm & 20 mm) and HRSG-4 Inlet line (10 mm & 20 mm), near the GT-IV Gas metering station area and it is observed that Flash Fire & 12.5 Kw/m² Jet Fire radiation intensity may affect the nearby equipment's in GT-IV area.

It is recommended to select the electrical fittings in GT-IV package as per the Hazardous Area Classification study and install the hydrocarbon & fire detectors at strategic locations in GT-IV area. It is also recommended to provide adequate passive fire protection for the supports of equipment's / pipe racks in GT-IV area and ensure adequate fire-fighting provisions in GT-IV area.

It is also recommended to ensure proper electrical fittings selection & hydrocarbon gas evacuation / ventilation for the GT Hall (Indoor) in event of hydrocarbon leakage inside GT Hall (Indoor). SOP to address steps to be taken by operator in event of gas leakage inside GT Hall (Indoor). Adequate provisions for gas / fire detection & remote isolation for Natural Gas lines to be provided inside GT Hall (Indoor).

Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk.

a) Recommendations for Construction Safety during execution of the Project

- ✓ Adequate barricading of the new facilities to be done from existing running facilities during construction phase. Hydrocarbon / toxic detectors to be placed along the barricading suitably to detect any hydrocarbon / toxic gas in vicinity of construction area. Also, adequate firefighting & toxic gas handling arrangement are to be ensured in the construction area. Ensure training of persons associated with construction activities for response during fire & toxic gas release.
- ✓ Proper material movement path within the Complex shall be identified during the construction phase of the project.
- ✓ Detailed HSE Plan & HSE Philosophy to be developed by contractors during construction phase of the project, in line with client's safety requirements.

b) General Recommendations

- ✓ No new Operator Cabin / manned station to be located inside battery limits of new/ proposed GT-IV.

- ✓ Proper checking of contract people for smoking or inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition.
- ✓ Ensure vehicles entering the Complex are fitted with spark arrestors, as a mandatory item.
- ✓ In order to prevent secondary incident arising from any failure scenario, it is recommended that sprinklers and other protective devices are regularly checked to ensure they are functional.
- ✓ Mock drills to be organized at organization level to ensure preparation of the personnel's working in Complex for handling any hazardous situation.
- ✓ For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector.

c) Mitigating Measures

Mitigating measures are those measures in place to minimize the loss of containment event and, hazards arising out of Loss of containment. These include:

- ✓ Early detection of an undesirable event (HC leak, Toxic gas leak, Flame etc.) and development of subsequent quick isolation mechanism for major inventories.
- ✓ Measures for controlling / minimization of Ignition sources inside the complex.
- ✓ Active and Passive Fire Protection for critical equipment's and major structures
- ✓ Effective Emergency Response plans to be in place.

d) Ignition Control

- ✓ Ignition control will reduce the likelihood of fire events. This is the key for reducing the risk within facilities processing flammable materials. As part of mitigation measure it strongly recommended to consider minimization of the traffic movement within the Complex.

e) Escape Routes

- ✓ Ensure sufficient escape routes from the site are available to allow redundancy in escape from all areas.
- ✓ Ensure sufficient number of windsocks throughout the site to ensure visibility from all locations. This will enable people to escape upwind or crosswind from flammable / toxic releases.

- ✓ Provide sign boards marking emergency/safe roads to be taken during any exigencies.

f) Others

- ✓ Ensure removal of hammer blinds from the process facilities, if any.
- ✓ Closed sampling system to be considered for pressurized services like Natural Gas, LPG, Propylene etc.
- ✓ Recommended to use portable HC detector during sampling and maintenance etc.
- ✓ Provide breathing apparatus at strategic locations inside Complex

For ERTO

- Consequence outcomes (radiation, explosion → & Toxic dispersion) are modelled for Acid Gas line to Heat Recovery Unit (20 mm leak) and it is observed that LFL hazard zone may reach up to a distance of 2 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 59 m from leak source affecting the existing vacant Room and nearby approach road to Guest House.

It is recommended to install Toxic gas detectors with sirens at strategic locations at ERTO Package and traffic to be restricted on nearby approach road to Guest House in event of any leakage in ERTO Package. Also it is recommended to ensure that there is no permanent manned station / continuous human presence in the affected area of H₂S IDLH concentration of 100 ppm.

- Consequence modelling (radiation, explosion → & Toxic dispersion) is carried out for Acid Gas line to Heat Recovery Unit (50 mm leak) and it is observed that LFL hazard zone may reach up to a distance of 5 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 128 m from leak source affecting the existing vacant Room, nearby approach road to Guest House, GSU – I, II & III, C2-C3 Plant, C2-C3 Mechanical Store, SRR on northern side, GPG Store.

Hence, it is recommended to install Toxic gas detectors with sirens at strategic locations at ERTO Package. Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk. It is also recommended to ensure adequate fire-fighting provisions & Breathing Apparatus at ERTO Package.

1.7 PROJECT BENEFITS

The benefits of proposed project are as follows:

Cogeneration Power Plant

The proposed co-generation plant shall use natural gas as the fuel for power generation. Natural gas is considered as a 'cleaner source' of thermal energy, having low carbon Intensity as compared to coal because:

- ❖ Substantial amount of heat is generated from combustion of natural gas as compared to coal, forming water as combustion product, which is not harmful to environment.
- ❖ The atomization of fuel is better during combustion as compared to coal, as the gas molecules get rigorously mixed with air molecules providing oxygen for combustion. This
- ❖ helps in reduction of 'excess air quantity, in combustion and thereby increasing the 'flame temperature' and reducing flue gas losses.
- ❖ There are hardly any incombustibles (e.g. Ash) in natural gas as compared to coal. Hence combustion of natural gas does not lead to particulate matter generation.
- ❖ Moreover, the sulphur content of sweetened natural gas (in form of H₂S), which will be used in the proposed project, will be negligible. Hence hardly any Sulphur-dioxide will be generated.

Enhanced Reactive Thermal Oxidiser (ERTO) system

- ❖ ONGC Uran Pant is processing 11.5 MMSCMD of Natural Gas from Mumbai Offshore and produces approximately 3800 TPD of Value Added Products (like LPG/C₂C₃ & Naphtha) from Natural Gas & Associated Condensate contributing to the national exchequer.
- ❖ It has been observed that the average concentration of H₂S in natural gas feed to Uran plant is 118 ppm. For mitigation of H₂S, from Acid gas, Uran plant studied various technologies and finally selected ERTO process as per recommendation of NEERI, Nagpur.

Natural Gas Sweetening is not a common process and in India there are only two to three such plants using the Natural Gas Sweetening process. Hence, this makes it a niche area of technology. The selection of the H₂S handling process is unique to the feed to the Unit and varies from process to process. Many critical factors such as the concentration of H₂S in the acid gas, quantity of acid gas generated, the ease of handling the by-products of the Acid Gas removal process are crucial to selection of the process. The selection of ERTO was made after meticulous consideration of all such aspects, in consultation with NEERI.

The proposed project would generate some direct and indirect employment opportunities during construction and operation phases, which will benefit the local people. Local skilled and unskilled labour will be required during construction and operation phase. Improvement in the overall socio-economic status of the vicinity of project area, in the thematic areas of health, education, livelihood and infrastructure is expected.

CHAPTER – 1

INTRODUCTION

1.0 INTRODUCTION

1.1 PURPOSE OF THE PROJECT

Oil and Natural Gas Corporation Limited (ONGC Ltd.) is India's Top Energy Company and ranks 20th among global energy majors. ONGC ranks 14th in 'Oil and Gas operations' and 220th overall in Forbes' Global 2000. Acclaimed for its Corporate Governance practices, Transparency International has ranked ONGC 26th among the biggest publicly traded global giants. It is one of the most valued public enterprise in India, and one of the highest profit-making and dividend-paying. ONGC has a unique distinction of being a company with in-house service capabilities in all areas of Exploration and Production of oil & gas and related oil-field services. Winner of the Best Employer award, a dedicated team of over 33,927 professionals toil round the clock in challenging locations. Its wholly-owned subsidiary ONGC Videsh Limited (OVL) is the biggest Indian multinational in the energy space, participating in 36 oil and gas properties in 17 countries. ONGC's subsidiary Mangalore Refinery and Petrochemicals Limited (MRPL) is a Schedule 'A' Miniratna, with a single-location refining capacity of 15 million tons per annum. ONGC is the principal producer of oil and natural gas in the country. The company operates a number of off-shore and on-shore oil & gas wells in Assam, Tripura, Mizoram, off the coast of Andhra Pradesh, Gujarat and off the Maharashtra – Gujarat Coast in the Arabian Sea. The off-shore oil and gas fields (Bombay High, Heera, Mukta etc.) in the Arabian Sea account for more than half of India's oil & gas production. Crude Oil and Associated Gas produced at Mumbai High and other satellite fields are being transported to Uran through 203 km long subsea pipeline viz. 30" and 26" pipeline respectively.

ONGC is the owner and operator of the Uran oil and gas processing plant. Maharatna ONGC is the largest producer of crude oil and natural gas in India, contributing around 70% of Indian domestic production. The crude oil is the raw material used by downstream companies like IOC, BPCL, HPCL to produce petroleum products like Petrol, Diesel, Kerosene, Naphtha, LPG. The plant processes 20 million tonnes per year (Mt/yr) of crude oil and 16 million standard cubic metres per day (MMSCMD) of natural gas. Crude oil received at Uran is finally stabilized at the CSU plant and water is separated out by de-hydrator before sending to storage tanks. From Natural Gas value added products viz., 0.625 Mt/yr of LPG, 0.625 Mt/yr of C2-C3 and 0.33 Mt/yr of naphtha are produced.

Part of the natural gas produced at the plant is utilized as fuel in a cogeneration power plant comprising of three gas turbines (total cap. 58.8 MW) and heat recovery steam generators (total cap. 240 TPH) and 90 TPH gas fired boiler to generate power and steam to meet the plant's own requirements. In order to process additional C-series gas from offshore, additional gas processing facilities such as LPG-III, GSU-III, CFU-III & CHU-IV were installed in 2013. Power requirement is approximately 20 MW (Continuous) and 60 TPH Steam from HRSG.

The proposed project envisages installation of an additional gas turbine (Cap. 20 MW) and heat recovery steam generator (cap. 60 TPH) within the existing plant. The feed gas for the new gas turbine will be natural gas like the existing ones.

The Uran Plant has a gas sweetening unit which removes H₂S from the natural gas recovered at the plant. Presently this H₂S is discharged through a tall stack.

ONGC is installing an Enhanced Reactive Thermal Oxidiser (ERTO) system, the first of its kind in the country which will virtually eliminate H₂S from the plant. The H₂S will be oxidized to SO₂. The combustion gases will be scrubbed with sodium hydroxide solution in a wet scrubber. The scrub liquid, containing mainly sodium sulfite, shall be diluted with treated effluent from ETP and finally discharged into the sea through a diffuser.

As per the Ministry of Environment and Forests (MoEF), New Delhi, any new project or modernization or expansion project need to have an Environmental Clearance from MoEFCC. In accordance with this, ONGC has decided to conduct Environmental Impact Assessment (EIA) study. Based on the TOR, three months (12 weeks) non-monsoon baseline data of March- May, 2017 was collected and analyzed.

M/s ONGC has entrusted M/s Engineers India Limited (EIL) to carry out environment impact assessment study and preparation of environmental management plan for various environmental components of the proposed project. EIL is an accredited consultant for carrying out EIA studies by Quality Council of India Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics) [Sl. no. 5 (c), Category A as per 2006 EIA Notification].

MOEF APPROVED TERMS OF REFERENCE FOR EIA

The Expert Appraisal Committee (Industry) for appraisal of Industrial Projects-2 considered the ONGC proposal for approval of TOR for EIA study for the proposed project. Based on the review of the documents submitted by the ONGC, the Committee accorded Terms of Reference (TOR) vide letter no. J-11011/635/2008-IA.II(I) dated 22nd March, 2018 for incorporating the same in the EIA report. The approved TOR is attached as **Annexure-I**.

1.2 DETAILS OF PROJECT PROPONENT

Oil and Natural Gas Corporation Limited (ONGC Ltd.) is the project proponent for the proposed Additional Cogeneration Power Plant (20 MW capacity Gas Turbine and 60 TPH capacity Heat Recovery Steam Generator) and an Enhanced Reactive Thermal Oxidiser (ERTO) system within ONGC-Uran onshore oil & gas processing plant complex which is located at Nagaon Village, Uran Tehsil, Raigarh District, Maharashtra.

1.2.1 PROJECT PROPONENT

1.2.1.1 Address of the Project Proponent

The address for the correspondence is:

Mr. Rajeeva Kumar
DGM (Chemistry), CHSE
Corporate HSE, Oil and Natural Gas Corporation Limited
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1.2.1.2 Particulars of EIA Consultant

The EIA consultant is Engineers India Limited (EIL), New Delhi. The complete address for correspondence is given below.

Mr.R.B.Bhutda
Head, EIA Department
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Research & Development Complex,
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1.3 BRIEF DESCRIPTION OF THE PROPOSED PROJECT

1.3.1 Nature and size of the project

Part of the natural gas produced at the plant is utilized as fuel in a cogeneration power plant comprising of three gas turbines (total cap. 58.8 MW) and heat recovery steam generators (total cap. 240 TPH) and 90 TPH gas fired boiler to generate power and steam to meet the plant's own requirements. In order to process additional C-series gas from offshore, additional gas processing facilities such as LPG-III, GSU-III, CFU-III & CHU-IV were installed in 2013. Power requirement is approximately 20 MW (Continuous) and 60 TPH Steam from HRSG.

The proposed project envisages installation of an additional gas turbine (Cap. 20 MW) and heat recovery steam generator (cap. 60 TPH) within the existing plant. The feed gas for the new gas turbine will be natural gas like the existing ones.

The Uran Plant has a gas sweetening unit which removes H₂S from the natural gas recovered at the plant. Presently this H₂S is discharged through a tall stack. ONGC is installing an Enhanced Reactive Thermal Oxidiser (ERTO) system, the first of its kind in the country which will virtually eliminate H₂S from the plant. The H₂S will be oxidized to SO₂. The combustion gases will be scrubbed with sodium hydroxide solution in a wet scrubber. The scrub liquid, containing mainly sodium sulfite, shall be diluted with treated effluent from ETP and finally discharged into the sea through a diffuser.

The proposed project is coming with existing ONGC-Uran plant area. The total ONGC-Uran plant area is 112 ha. Total plot area for GT-IV and ERTO inside plant is 5500 sq. m. Proposed area to be developed for proposed additional Cogeneration plant and ERTO is 60 ha which is within the plant boundary.

The estimated capital cost for the proposed project is Rs. 26895 Lakhs.

1.3.2 Location of the project

ONGC's Uran Plant is located on a peninsula on the southern side of Mumbai Harbour between latitudes 18°52'25.5" N & 18°51'18.4" N and longitudes 72°55'27.4" E &

72°56'03.2" E. ONGC-Uran onshore oil & gas processing plant complex is located at Nagaon Village, Uran Tehsil, Raigarh District, Maharashtra. The plant is spread over an area of 112 ha.

The plant site is well connected by road off the Mumbai - Panvel road at Uran. It is about 60 km from the city of Mumbai. The plant site is linked by SH-54 to NH-4B which passes about 11 km from the plant site (NH-4B serves Jawaharlal Nehru Port).

The nearest railway station is Panvel on the Mumbai CST – Panvel Harbour line (Mumbai Suburban Railway), which is about 24.5 km north-east of the Uran Plant. A new line from Nerul / Belapur on the same route to Uran is under construction. Uran is also connected by sea opposite to the Mumbai port. Location wise, it is approximately 7 km away from Jawaharlal Nehru Port at Sheva. The distance (by road) of the project site from nearest station/port/airport/city are as given below:

- ❖ Panvel Railway station: 24.5 km
- ❖ Mumbai Port (JNPT): 7 km
- ❖ Mumbai Airport: 55 km
- ❖ Mumbai City: 40 km.

The details of environmental setting is given in table 1.1 and the location & study area map of plant surrounding 10 km radius are given in Figures 1.1& 1.2 respectively.

Table 1.1: Details of Environmental Setting

S.No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	No	
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	No	
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	No	
4	Inland, coastal, marine or underground waters	No	
5	State, National boundaries	No	
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	
7	Defence installations	Yes	Defence installation viz. Radar Station of Indian Air Force exists at Uran.
8	Densely populated or built-up area	Yes	The proposed projects are located within existing petro chemical complex,

			which is located in the industrial belt of Uran. The nearest village is Nagaon in Uran taluka.
9	Areas occupied by sensitive man-made land uses (<i>hospitals, schools, places of worship, community facilities</i>)	No	The proposed projects are located within existing petro chemical complex. It does not have hospital, school etc.
10	Areas containing important, high quality or scarce resources (<i>ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals</i>)	No	
11	Areas already subjected to pollution or environmental damage. (<i>those where existing legal environmental standards are exceeded</i>)	No	
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (<i>earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions</i>)	No	



Fig. 1.1: Google Earth Image of the Existing ONGC-Uran Plant



Figure 1.2: 10 km Study area map

1.3.3 Importance and Benefits of the project

The proposed co-generation plant shall use natural gas as the fuel for power generation. Natural gas is considered as a 'cleaner source' of thermal energy, having low carbon intensity as compared to coal because:

- ❖ Substantial amount of heat is generated from combustion of natural gas as compared to coal, forming water as combustion product, which is not harmful to environment.
- ❖ The atomization of fuel is better during combustion as compared to coal, as the gas molecules get rigorously mixed with air molecules providing oxygen for combustion. This helps in reduction of 'excess air quantity, in combustion and thereby increasing the 'flame temperature' and reducing flue gas losses.
- ❖ There are hardly any incombustibles (e.g. Ash) in natural gas as compared to coal. Hence combustion of natural gas does not lead to particulate matter generation.
- ❖ Moreover, the sulphur content of sweetened natural gas (in form of H₂S), which will be used in the proposed project, will be negligible. Hence hardly any Sulphur-di-oxide will be generated.

This power plant operating on cleaner fuel like Natural Gas will lead to lower carbon dioxide (a Green House Gas) emissions for producing equivalent amount of power as compared to power plants operating on other fuels like coal/ oil/ naphtha.

The project will also increase the installed electricity generating capacity of the plant making the plant self-sufficient.

The project is a clean fuel power project, which will use natural gas as a fuel for power generation. Since the CO₂ emission due to combustion of natural gas is substantially less as compared to combustion of coal or naphtha, the project shall help in reducing GHG emissions.

Further since the project will be fuelled by natural gas; it will positively contribute towards the reduction in (demand) use of coal. The environmental problems associated with mining and land distance transportation of coal will be avoided.

ONGC Uran Pant is processing 11.5 MMSCMD of Natural Gas from Mumbai Offshore and produces approximately 3800 TPD of Value Added Products (like LPG/C2C3 & Naphtha) from Natural Gas & Associated Condensate contributing to the national exchequer. It has been observed that the average concentration of H₂S in natural gas feed to Uran plant is 118 ppm. For mitigation of H₂S, from Acid gas, Uran plant studied various technologies and finally selected ERTO process as per recommendation of National Environmental Engineering and Research Institute (NEERI), Nagpur. After detailed study NEERI has recommended Enhanced Reactive Thermal Oxidizer (ERTO) plant, which is most suitable for Uran plant and a proven technology for H₂S mitigation.

The proposed project will generate employment, though only during the construction phase. CSR activities undertaken by ONGC shall improve the quality of the life of people in surrounding habitations. Overall livelihood and infrastructure of surrounding localities are expected to be positively changed.

1.3.4 List of industries around the project

Uran area is a major industrial area. Stimulated by the setting up of the plant to process hydrocarbons (oil & gas) from the offshore oil-fields, several industries have come up in the vicinity. Industrial growth has accelerated with the setting up of Jawaharlal Nehru Port. Nagothane, which is also located in Raigad district ~40 km south-east of Uran, has become a major centre for petro-chemical industries. The major industries in Uran include:

1. Jawaharlal Nehru Port (8 km North-north-east).
2. Mumbai Port's Oil Tanker Terminal, Jawahar Deep (~9 km North-north-west)
3. Naval Armaments Depot, Mora (~3 km North-north-west)
4. LPG Bottling Plant of Bharat Petroleum Corporation Limited (4.3 km East)
5. 672 MW gas turbine based combined cycle power plant of Maharashtra State Power Generation Company Ltd., Uran (3.8 km East-North-East)
6. Abrasives Plant of M/s Grindwell Norton Ltd., Mora Village (4 km North)
7. IOT Infrastructure & Energy Services, Navghar (6 km East-North-East)

Jawaharlal Nehru Port handles maximum number of containers among all Indian ports. Consequently a number of Container Freight Stations (CFSs) have come in the area. Some of the CFSs within 10 km of ONGC's Uran Plant are:

1. Dronagri CFS of M/s Hind Terminals Pvt. Ltd. (4.6 km East-north-east)
2. CWC Logistics Park (4.8 km East)
3. CFS of M/s Balmer Lawrie (5.7 km East)
4. ULA CFS (5.5 km East)
5. CFS of M/s Gateway Distriparks Ltd. (5.9 km East-north-east)
6. Maersk Annex CFS (6.1 km East-north-east)

Two major oil refineries (of BPCL and HPCL) are located about 45 km (by road) north of ONGC's Uran Plant.

1.4 PROJECT IMPLEMENTATION SCHEDULE

The proposed project of is expected to be mechanically completed in 28 months from the Zero date (After receipt of Environmental Clearance).

1.5 EARLIER ENVIRONMENTAL CLEARANCE AND THEIR COMPLIANCE

There are five environmental clearances issued to ONGC-Uran from MoEFCC since 1990. ONGC-Uran plant is regularly submitting its compliance report to regional office of MoEFCC at Nagpur. All environment clearances accorded from MoEF are given in brief in below mentioned Table 1.2 and compliance to all environmental clearances is attached as **Annexure-II**.

Table 1.2: Previous Environmental Clearances issued to ONGC-Uran plant from MoEFCC

SI No	Projects/ Units	Environment Clearance document	Date	Compliance
1	5,70,000 MTPA Ethane-Propane Recovery Unit (EPRU)	J-11011/12/87-IA	14.06.1990	Complied
2	Additional Co - Generation Facility	J-13011/18/95-1A-II	01.12.1995	Complied
3	Uran-Trombay– Jawahar Dweep 36" Oil pipeline Project	J-82/2004-IA, III	20.12.2006	Complied
4	20" Uran Trombay Gas Pipeline Project	11-61/2007-IA-III	02.11.2007	Complied
5	Additional Process Facilities & Debutanisation Projects	J-11011/635/2008-IA-II(I)	20.09.2010	Complied

A certified copy of the latest monitoring report from Regional Office, MoEFCC (Nagpur) on the status of compliance of conditions stipulated in all environmental clearances is attached in **Annexure III**.

1.6 SCOPE OF THE STUDY

The study covers core area of 10 km radius circle with the existing ONGC-Uran plant boundary. The scope of study broadly includes:

- To conduct literature review and to collect data relevant to the study area;
- To establish the baseline environmental status of the study area by using one season baseline environmental data;
- To identify various existing pollution loads due to various activities in the ambient levels;
- To predict incremental levels of pollutants in the study area due to the proposed project;
- To evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies

-
- To prepare an Environment Management Plan (EMP) outlining the measures for improving the environmental quality; and
 - To identify critical environmental attributes required to be monitored.

The literature review includes identification of relevant articles from various publications, collection of data from various government agencies and other sources.

1.7 ORGANIZATION OF THE REPORT

The proposed project would naturally have implications on the neighborhood with reference to socio-economic aspects of society, environmental attributes such as land, water, air, aesthetics, noise, flora and fauna. In assessing the environmental impact, collection, collation and interpretation of baseline data is of prime importance. Environmental Impact analysis and assessment which is required for every industrial project should preferably be carried out at the planning stage itself.

The matrix method which gives cause-effect relationship between an activity and environmental parameter has been adopted in preparing this report. The basic objective of identification of impacts is to aid the proponents of the project to rationalize the procedure for an effective environment management plan, leading to an improvement in environmental quality as a result of the location of the proposed project. This has been attempted by the following procedures:

- Collection, collation and analysis of baseline data for various environmental attributes;
- Identification of impacts;
- Impact assessment through modeling;
- Evaluation of impacts leading to preparation of environmental management plan; and
- Outlining post project monitoring methodology.

1.7.1 CONTENTS OF THE REPORT

The report has been divided into ten chapters and presented as follows:

Executive Summary

Chapter-1.0: Introduction

This chapter provides background information of the proposed project, brief description and objectives of the project, description of the area, scope, methodology and organization of the study.

Chapter-2.0: Project Description

This chapter presents the background information on the existing and post expansion activities, process being adopted, sources of pollution and control thereof.

Chapter-3.0: Description of Environment

This chapter presents the methodology and findings of field studies undertaken to establish the baseline conditions.

Chapter-4.0: Anticipated Environment Impacts and mitigation measures

This chapter details the inferences drawn from the environmental impact assessment of “The project” during construction and operational phase. It describes the overall impacts of the proposed project and underscores the areas of concern which need mitigation measures.

Chapter-5.0: Environment Monitoring Programme

This chapter provides technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)

Chapter-6.0: Environment Management Plan (EMP)

This chapter provides recommendations for Environment Management Plan (EMP) including mitigation measures for minimizing the negative environmental impacts of the project. Environmental monitoring requirements for effective implementation of mitigate measures during construction as well as during operation of the project along with required institutional arrangements for their implementation. Budgetary cost estimates for mitigation measures are also brought out.

Chapter-7.0: Additional Studies

This chapter covers Public Hearing, risk involved in the proposed facilities, storages and utilities and Occupational Health and Safety.

Chapter-8.0: Project Benefits

This chapter presents the details of Local area development programmes that are being undertaken in nearby villages at proposed plant.

Chapter-9.0: Disclosure of Consultants

This chapter contains the list of various experts engaged in preparing the EIA report along with brief introduction of the consultancy.

CHAPTER – 2

PROJECT DESCRIPTION

2.0 INTRODUCTION

Part of the natural gas produced at the ONGC-Uran plant is utilized as fuel in a cogeneration power plant comprising of three gas turbines (total cap. 58.8 MW) and heat recovery steam generators (total cap. 240 TPH) and 90 TPH gas fired boiler to generate power and steam to meet the plant's own requirements. In order to process additional C-series gas from offshore, additional gas processing facilities such as LPG-III, GSU-III, CFU-III & CHU-IV were installed in 2013. Power requirement is approximately 20 MW (Continuous) and 60 TPH Steam from HRSG.

The proposed project envisages installation of an additional gas turbine (Cap. 20 MW) and heat recovery steam generator (cap. 60 TPH) within the existing plant. The feed gas for the new gas turbine will be natural gas like the existing ones.

The Uran Plant has a gas sweetening unit which removes H₂S from the natural gas recovered at the plant. Presently this H₂S is discharged through a tall stack. ONGC is installing an Enhanced Reactive Thermal Oxidiser (ERTO) system, the first of its kind in the country which will virtually eliminate H₂S from the plant. The H₂S will be oxidized to SO₂. The combustion gases will be scrubbed with sodium hydroxide solution in a wet scrubber. The scrub liquid, containing mainly sodium sulfite, shall be diluted with treated effluent from ETP and finally discharged into the sea through a diffuser.

This chapter highlights the features of proposed Cogeneration Power Plant (20 MW capacity Gas Turbine and 60 TPH capacity Heat Recovery Steam Generator) and an Enhanced Reactive Thermal Oxidiser (ERTO) system within ONGC-Uran onshore oil & gas processing plant complex with respect to plant configuration, raw material requirement, utilities and services, infrastructural facilities and sources of waste generation, their quantity, treatment and safe disposal of the waste.

The estimated capital cost for the proposed GT-IV and ERTO project Rs. 26895 Lakhs. The proposed project is expected to be mechanically completed in 28 months from the Zero date (After receipt of Environmental Clearance).

2.1 EXISTING PLANT

2.1.1 Main Production Units

In 1978, an oil and gas terminal was set up at Uran to receive Crude oil and natural gas from offshore fields in the Arabian Sea off Mumbai (then called Bombay). In 1980 Crude Stabilization Unit was set up to Store, Process and Supply stabilized crude to downstream consumer; the first plant in India to extract Liquefied Petroleum Gas from Natural Gas was commissioned. Four fingers of Slug Catcher were also commissioned in the same year. Over the years the plant has been expanded and upgraded. In 1984, two gas turbine based co-generation units were commissioned to provide un-interrupted power. In 1987, an Effluent Pre-Treatment Plant (EPTP) was commissioned. In 1990, an Ethane – Propane Recovery Unit was commissioned. In 2000, the third gas turbine based co-generation units was commissioned. In 2003, a Flare Gas Recovery Unit was commissioned. In 2004, an Intermediate Tank Vapour Recovery Unit was commissioned.

Crude Oil and Associated Gas produced at Mumbai High and other satellite fields are being transported to Uran via 203 Km long subsea pipeline viz. 30" and 26" pipeline respectively. Crude Oil, Natural Gas and Condensates are separated out and processed;

Crude received at Uran is finally stabilized at the CSU plant and water is separated out by de-hydrator before sending to storage tanks. Besides oil processing, huge quantity of gas is also processed at Uran to produce value added products like LPG, LAN, and C2-C3 (Ethane & Propane) etc. The Uran plant has following process units:

Table-2.1: Existing Process Units in Uran Plant

Units	Nos.	Capacity
Crude Stabilization Unit	5 trains (4 working + 1 standby)	20 x 10 ⁶ t/yr
LPG Recovery Units	3 Nos. (2 working + 1 standby)	16.95 x 10 ⁶ m ³ /day
Gas Sweetening Unit	3 Nos. (2 working + 1 standby)	15.75 x 10 ⁶ m ³ /day
Ethane-Propane Recovery Unit	1 no.	8.54 x 10 ⁶ m ³ /day
Condensate Fractionation Units	3 nos.	195 (35 + 60 + 100) t/hr

In addition the plant also has the following units:

- ❖ Offsite and Storage : 02 Units
- ❖ Co- Generation Plant with HRSG : 03 Units
- ❖ Effluent Treatment Plant : 01 Unit
- ❖ Utilities and Flare : 02 No

The processing complex at ONGC, Uran is of strategic importance as it handles 60% of hydrocarbons India Produces. ONGC, Uran plant has won many safety awards from Ministry of Petroleum & Natural Gas, Govt. of India for its safe working & safe planning. In view of its importance, everybody inside the plant has to ensure that care for the safety of the plant is given top most priority. Every job inside the plant has to be thoroughly planned and executed, without any safety violation. No relaxation is permitted in safety aspects.

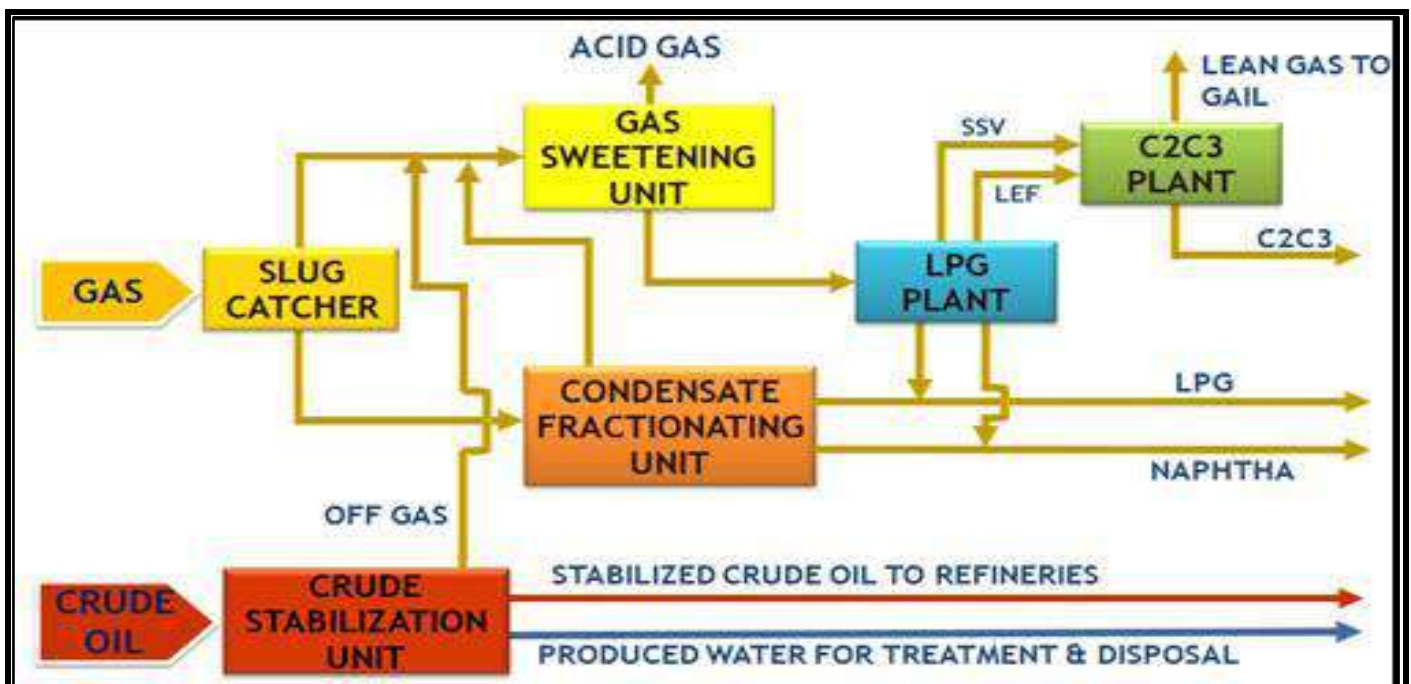


Fig. 2.1: Process Flow Diagram of Uran Plant

The detailed lay-out of the plant is given below as Fig. 2.2. The plot plan of the co-generation unit and ERTO has been also been given as **Annexure-IV**.

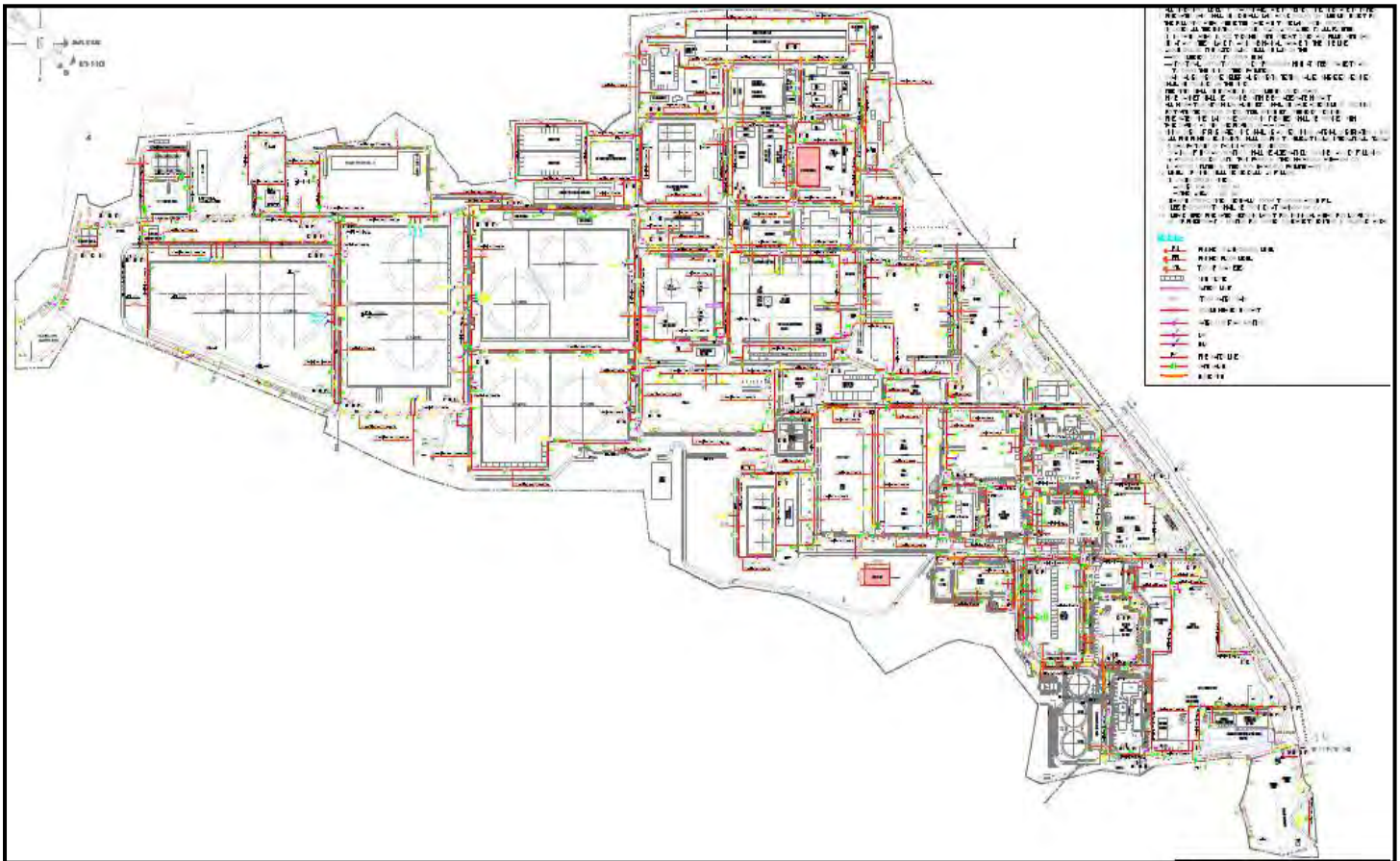


Fig. 2.2: Lay-out of the ONGC-Uran plant

The Crude Oil recovered at the Uran Plant is pumped to ONGC's Trombay Terminal through a 24 km long 36 inch diameter pipeline. A 30 inch diameter pipeline from this pipeline moves part of the oil to Jawaharlal Nehru Port where the crude is loaded onto ships for despatch to refineries elsewhere. From the Trombay Terminal, crude oil is pumped to the nearby 6.0 MTPA capacity Hindustan Petroleum Corporation Ltd. (HPCL) Refinery and 12.0 MTPA capacity Bharat Petroleum Corporation Ltd.(BPCL) Refinery and to the Jawahar Deep tanker terminal of Mumbai Port where it is loaded onto ships for despatch to oil refineries elsewhere.

Part of the natural gas recovered at the Uran Plant is used to fuel three nos. gas turbine based combined cycle co-generation units which generate 60 MW electricity and 270 tonnes per hour steam. The rest of the natural gas is pumped to the Trombay Terminal through a 20 inch diameter pipeline from where the gas is supplied to various consumers through Gas Authority of India Ltd. (GAIL). GAIL also supplies gas to various consumers directly from the Uran Plant. ONGC is planning to install another natural gas fuelled co-generation unit comprising of 20 MW gas turbine and a 60 TPH HRSG.

The LPG produced at the Uran Plant is temporarily stored in 4 nos. Horton Spheres (2 x 750 m³ + 2 x 1500 m³) before being pumped to BPCL's Uran Terminal through a 8 km long 8 inch diameter pipeline. Propane & Ethane (C₂-C₃) are pumped to M/s Reliance Industries Ltd.'s petrochemicals plant at Nagothane through a 21 km long 10 inch diameter pipeline. The naphtha produced at the Uran Plant is pumped to the facilities of M/s IOT

Infrastructure & Energy Services Ltd. through a 8 km long 10 inch diameter pipeline for export.

2.1.2 Air Pollution Control

The plant has three nos. gas turbine based co-generation units in operation. These gas turbines are fueled by natural gas produced at the plant. A 4th co-generation has been planned. The principal pollutants emitted from gas turbines are NO_x and SO₂. The emission of SO₂ is controlled by reducing the Hydrogen Sulphide (H₂S) in the natural gas recovered from the well fluids processed at the plant in a Gas Sweetening Unit. The emissions of NO_x will be reduced by installing Dry Low NO_x (DLN) combustors in the new gas turbine which will reduce the NO_x content of the combustion gases to maximum of 25 ppm

The Uran Plant has a gas sweetening unit which removes H₂S from the natural gas recovered at the plant. Presently this H₂S is discharged through a tall stack. ONGC is installing an Enhanced Reactive Thermal Oxidiser (ERTO) system, the first of its kind in the country which will virtually eliminate H₂S from the plant. The H₂S will be oxidized to SO₂. The combustion gases will be scrubbed with sodium hydroxide solution in a wet scrubber. The scrub liquid, containing mainly sodium sulfite, shall be diluted with treated effluent from ETP and finally discharged into the sea through a diffuser.

The Uran Plant has installed a Flare Gas Recovery Unit (FGRU) to recover process plant tail gases which are otherwise led to the flare system. The FGRU shall recover valuable hydrocarbons from the tail gas going to flare header and reduce flaring to zero level. The quantity of tail gas varies from 30000 to 150000 standard cubic metres per day (scmd). The FGRU achieves the following benefits-

- Reduce the wastage of precious natural resources.
- Reduce the impact on environment and safety of the locality / surrounding areas.
- Achieve zero hydrocarbon emissions.
- Utilize recovered gas to produce value added products such as LPG, LAN, C₂, C₃.
- Reduce GHG emission into atmosphere.

There are two nos. atmospheric surge tanks. Substantial quantities of hydro-carbon gas are lost from these tanks to atmosphere due to breathing and flashing of oil at low pressure and can be recovered and reused as a fuel gas. ONGC is installing Tank Vapour Recovery Units (TVRUs). Presently there are 8 vents on top of each of the tanks. All the vents are provided with flame arrestors. The TVRUs have the capacity to recover 15000 scmd of hydrocarbon vapours. The TVRUs improve safety and reduce environmental hazard, without interfering in the crude stabilization process.

2.1.3 Effluent Treatment Plant

The principal effluent generated at the plant is water separated from well fluids (Produced Water). Presently ~2000 m³/day of Produced Water is generated. The analysis of this water is as follows:

- pH : 7.5
- Suspended solids : 303.1 mg/l
- BOD₃ : 243.2 mg/l
- COD : 1448 mg/l
- Total Dissolved Solids: 27490 mg/l

The effluent is treated in a 16800 m³/day capacity Effluent Treatment Plant (ETP). The ETP comprises of Surge Pond, Venturi, Corrugated Plate Interceptor (CPI), Pressure Sand Filters (PSF), Bio-Tower, Clarifier and Guard Pond. The process flow diagram of the existing ETP of the Uran Plant is shown in Fig. 2.3.

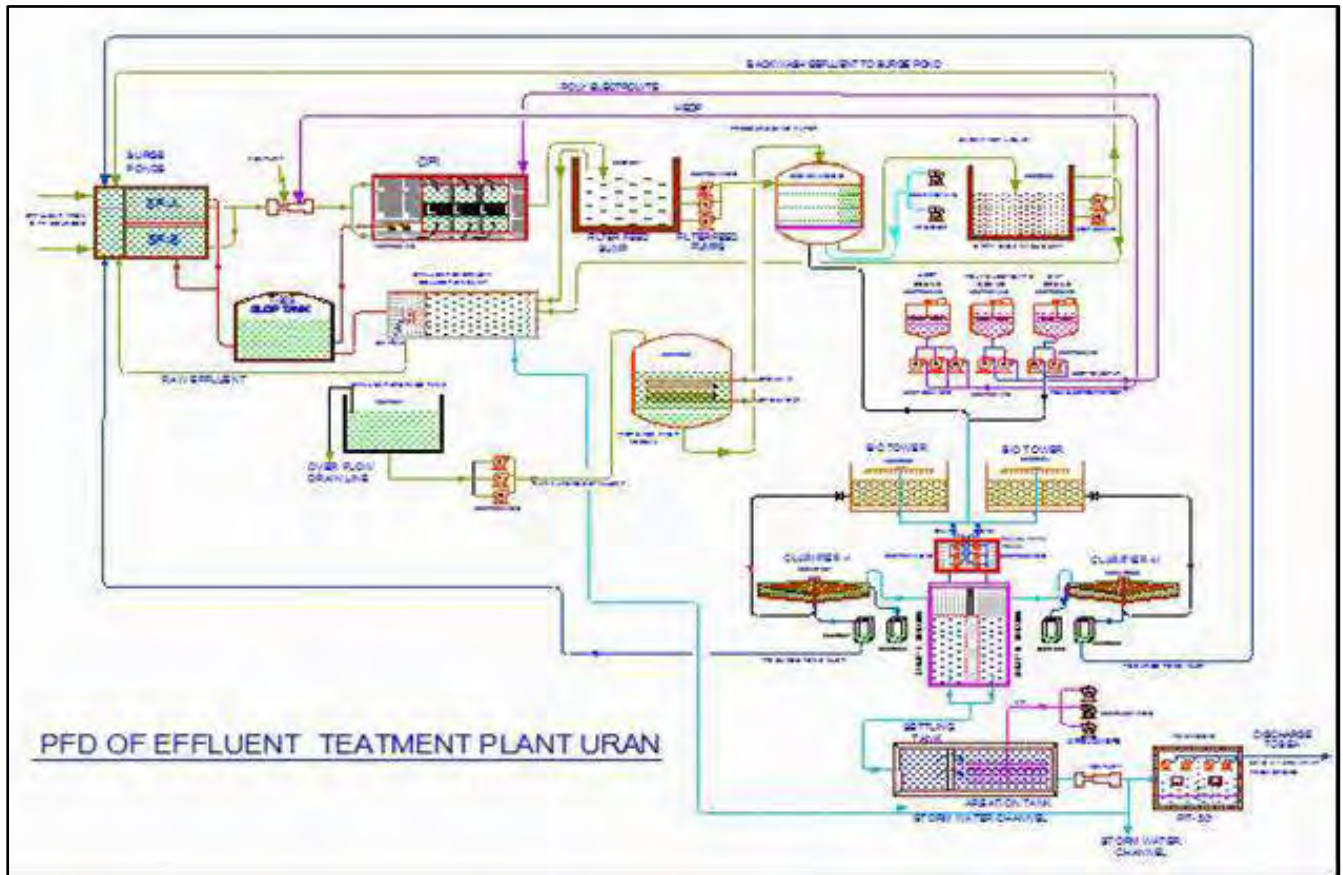


Fig. 2.3: Process Flow Diagram of Existing Effluent Treatment Plant

The analysis of the treated water is as follows:

- pH : 8.2
- Suspended solids : 32.2 mg/l
- BOD₃ : 21.5 mg/l
- COD : 151.33 mg/l
- Total Dissolved Solids: 10900 mg/l

These levels are within the maximum permissible limits for discharge of effluents in “Marine Coastal Waters” specified in “General Standards for Discharge of Environmental Pollutants Part – A: Effluents” issued by MoEFCC.

ONGC is upgrading the existing ETP at a cost of Rs.159.48 crores. The new ETP is expected to be commissioned by October, 2021. The modernization project envisages not only effluent treatment and disposal but also recovery and re-use of waste water and to capture volatile organic compounds. This shall ensure totally clean environment and saving of precious water. The modernization shall minimize emission of VOCs and increase recovery/ recycle/ re-use of water which will reduce the demand for fresh water. The slop oil recovered from ETP is sent to slop tank and then to Crude storage tanks. Sludge is sent to sludge pit. In the inlet of ETP, there are two numbers of surge ponds, namely SP A & B. These are open reservoirs for receiving effluent, capacity of each reservoir being 7500 m³.

In course of time sludge accumulation takes place and is taken up for cleaning. The pond which is to be taken up for cleaning, first the floating oil is recovered from it. The water from the bottom is pumped out. Next the sludge is shifted to oily sludge pit, located at tank farm area. The job of recovery of oil from sludge is outsourced. The Flow diagram of the new ETP is given Fig. 2.4.

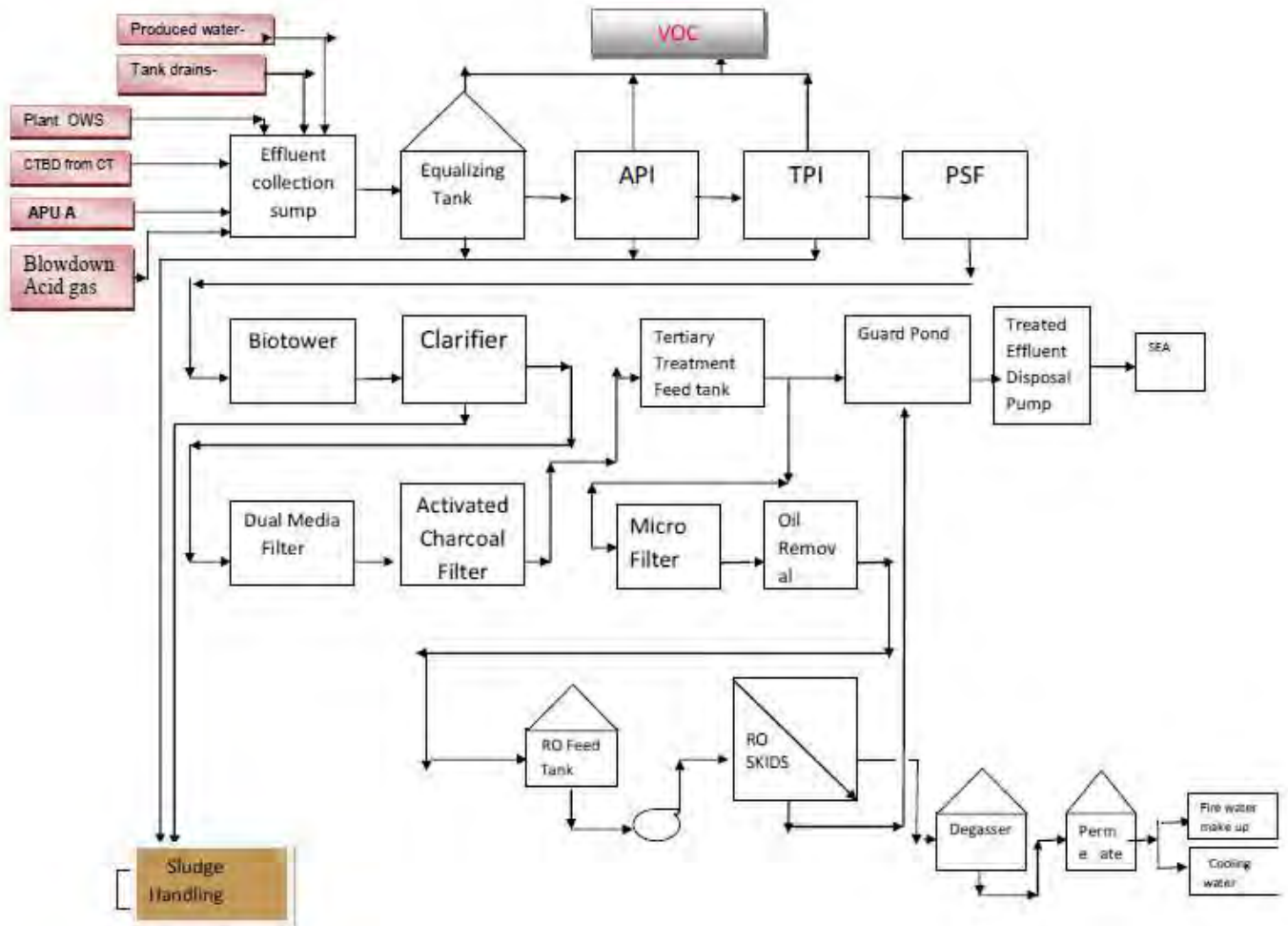


Fig.2.4: Process Flow Diagram of New ETP at Uran Plant

The treated effluent is discharged into the sea through a diffuser. The discharge area is located about 1.5 km off Pirwadi village. The residue/ bottom sludge from Crude storage tanks and ETP which is having less than 10% oil content is taken up for bio-remediation. This is done through M/s OTBL (a JV of ONGC and TERI). Bio-remediation is a process where the residue is mixed with equal quantity of fresh soil and mixed with Oil Zapper (a type of fertilizer which contains microbes as feed for bacteria). The process takes 6-12 months and Oil Zapper is added time to time and tilling is done. At the end of bio-remediation, the soil should have less than 1% of Total Petroleum Hydrocarbon (TPH); and grass growth takes place on this soil.

Approximately 3000 m³/day of ETP treated effluent are released through a submerged six port diffuser which guides the effluent into the sea. By use of diffusers, the brine will be quickly diluted and the quality of sea water will not change much.

a) Other Pollutants

Quantities of boiler blow-down and cooling tower blow-down are small. They are also discharged intermittently, especially boiler blow-down. These effluents are mixed with the well fluid water. Floor washings, which may contain oil, are also treated in the ETP.

b) Oil Spill Management

i) Preventive Measures

Preventive measures are aimed at reducing the chance of error as far as possible and to ensure that only best materials are used and maintained. The entire accident prevention is constantly concerned with the elimination of mistakes, and although complete success is probably an unattainable target, the use of a check-list system goes a long way to minimize errors. Prompt action in the event of accidental spillage is essential.

ii) Containment Measures

The containment measures must be capable of capturing oil that may discharge from a primary storage system (i.e., tank or pipe) such that the oil will not escape to the environment before clean-up occurs. Compliance requires the use of dikes, berms, retaining walls, curbing, spill diversion or retention ponds, absorbent materials or other equivalent measures. Under different sections of the rule, a quick drainage system is required for tank car or tank truck loading/unloading racks and secondary containment is required for all bulk storage containers.

Bulk storage containers must be constructed with a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. Secondary containment of bulk storage containers is typically accomplished by concrete or steel dikes, earth berms, double-wall tanks or remote impoundments. Examples of common appropriate containment measures for operational equipment include the following methods:

1. Absorbent Material

In the case of indoor hydraulic reservoirs (e.g. elevators, machinery etc.) appropriate containment may be achieved by placing absorbent materials around equipment to prevent spilled oil from reaching a floor drain or other drainage inlet. Absorbent materials are readily available in a variety of shapes and sizes.

2. Concrete Curbing

In the case of outdoor reservoirs (tanks, electrical equipment) appropriate containment may be achieved by constructing concrete curbing around the equipment to prevent the lateral migration of oil from reaching a drainage inlet before clean-up occurs. Curbing needs to be constructed around common outdoor pad.

3. Drainage Inlet Cover

These are placed over drainage inlet structures to prevent spilled oil from entering the drainage system and discharging into the environment. This option requires keeping the drainage inlet covered for all the time. The drainage inlet operations should be properly supervised and inspected in consistent with the rules. Drainage inlet covers are most effective when the surrounding surface is conducive to a tight seal and the area is free of debris (e.g. grit, sand, etc.)

2.1.4 Solid Wastes Management

ONGC Ltd. has entered into an agreement with M/s Mumbai Waste Management Ltd., who are operating a Common Hazardous Waste Treatment, Storage and Disposal Facility

(TSDF) at Taloja in Raigad District of Maharashtra at an aerial distance of ~28 km north-east of ONGC's Uran plant.

The TSDF has an incinerator and secured land-fill along with other necessary infrastructure for treatment of and disposal of industrial wastes. The solid wastes are segregated at the plant itself and stored in a dedicated waste storage facility at the plant. The wastes are transported by the TSDF's dedicated trucks with proper documentation from Uran to the TSDF site.

2.1.5 Existing Co-Generation Plant with Heat Recovery Steam Generators

The existing Captive Power Plant (CPP) of Uran Complex comprises of three Gas Turbine Generators (GTG) of Frame-V model and one Heat Recovery Steam Generator (HRSG) associated with each GTG. The gas turbines are started using a diesel engine, which is disconnected as soon as the gas turbine starts running on its own. The HRSGs are of supplementary fired type and also have Forced Draft fan (FD fan) for Forced Draft mode of operation. Each GTG produces 19.6 MW at site at ambient condition and each HRSG produces 60 TPH saturated steam at medium pressure (design pressure of 13.5 Kg/cm²) without any supplementary firing. HRSG-1 and HRSG-2 can achieve up to 75 TPH of steam generation with supplementary firing whereas the HRSG-3 can achieve up to 90 TPH with supplementary firing.

In the existing CPP, there is one package boiler from Thermax which was installed in 1990 and is old and has reliability/ maintainability issues for sustained operation. The IAEC boiler house in the CPP premises is currently not in use and the same is being used as store room.

The existing DA/DM (De-alkaline/ De-mineralised) plant with capacity of 2 X 55 m³ DA and 1 X 5.0 m³ DM caters to the DA/DM water requirement of the entire Uran complex including CPP. As per current industry practices, only DM water is used instead of DA water since it provides benefit of better (lesser) corrosion and deposition characteristics to the equipments and piping. The recently installed Additional Process Units (APU) are designed to use DM water and for this purpose one new DM plant capacity of 1 X 75 m³ has been added during installation of Additional Process Units (APU).

There is one returned Condensate Stabilization System (vessel V-306, V-308 & T-303) which receives the returned condensate coming from CSU along other process units. It separates the steam from the condensate and the recovered condensate is further used in deaerator for HRSGs. One new gas fired boiler (APU boiler of 90 TPH), as a part of APU project has been installed.

The Uran complex also has provision of Power import/ export from Maharashtra State Electricity Distribution Company Ltd. (MSEDCL). The Cogeneration plant Uran is run in synchronism with MSEDCL grid.

2.1.6 Other Facilities

The plant has all necessary facilities for receipt, storage and processing of well fluids. This includes storage facilities for stabilised crude oil (8 nos. 60,000 m³ capacity floating roof type tanks), LPG [4 nos. Horton Spheres (2 x 750 m³ + 2 x 1500 m³)], Naphtha (1 x 5000 m³ tank), Propane (1 x 350 m³ tank), C2 C3 (3 nos. Horton Spheres each of 1085 m³) and Natural Gas (3 x 250 m³ tank), facilities for treatment and disposal of effluents, gas sweetening units (3 nos.), electrical sub-stations, gas flaring systems (2 nos.), raw water storage facility, fire water tanks and other infrastructure. An Enhanced Reactive

Thermal Oxidiser to mitigate H₂S emissions is being installed. A sea water desalination plant has been planned. The existing 4 nos. LPG storage tanks are being replaced by 3 nos. Mounded LPG Bullets each of 1500 m³ capacity.

Acid and alkali required at the DA / DM water plant are received in tankers and discharged directly into 2 nos. storage tanks (each of 5 m³ capacity) located in the water treatment areas. The rest of solid chemicals are stored in the plant's Central Store and as per requirement of a particular period, are brought to local storage areas for consumption.

2.2 PROPOSED CO-GENERATION UNIT

As mentioned earlier the proposed additional co-generation shall comprise of a 20 MW gas turbine and a 60 TPH Heat Recovery Steam Generator (HRSG). The gas turbine will be fuelled by natural gas available in-house. The new units will have their own auxiliary systems.

The proposed system shall be based on standard Gas turbine model from gas turbine manufacturer. Gas turbine model of site rated output of 20 MW will meet the requirement of complex for 8 month and approx 19 to 20 MW of power to be imported from grid for the balance 4 months from grid considering one month shutdown per gas turbine.

The proposed HRSG of 60 TPH is similar to that of existing HRSG-3. However considering the reliability of gas turbine and all the other HRSGs already having FD fan mode, the FD fan mode for the proposed HRSG will be redundant. Hence, FD fan mode in HRSG is not considered.

2.2.1 Main Plant Description

a) Gas Turbine

In order to ensure reliability in the gas turbine, its design philosophy is based upon simplicity, robustness and the use of proven technology. The gas turbines will be of heavy duty industrial type which are already proven with numerous power producing installation and this class of gas turbine in the capacity range of approx 20 to 35 MW range are still the most commonly installed gas turbine in the country and abroad. A similar gas turbine is itself operating in the Uran complex for decades.

The gas turbine in this class are having a frame design with a minimum number of parts in a single-shaft arrangement operating at approximately 5000 rpm rotor speed. The compressor rotor and the turbine module form a single shaft, which rests in standard hydrodynamic bearings of the tilting pad type.

Modularization, few parts, long component life and easy inspection ensure long time between overhauls and low maintenance costs.

Bore scope ports are available for inspection of each compressor stage.

- ❖ Manholes are standard feature in this class of turbine for easy inspection of the compressor inlet bell mouth during standstill and operation.
- ❖ The compressor casing is in general vertically split in the longitudinal direction, which allows half of it to be removed for easy access to the rotor and stator parts.

- ❖ The rotor centre line is approx 1.5m /5ft above the grating, making inspections very convenient.

An overhead crane will be installed inside the gas turbine enclosure to facilitate maintenance.

b) Compressor Section

The compressor will be of a transonic type with the latest compressor aerodynamic design. It is typically a 17 stages compressor with ISO pressure ratio of 1:10. To minimise leakage over the blade tips, generally abradable seals are applied. The vane carrier of the high pressure section, stages where the blades are the shortest, is made from a low expansion material that helps keep clearances to a minimum.

Cooling air for the hot section of the turbine will be extracted from the compressor at different stages.

c) Turbine section

The typical two-stage turbine will be built as one module with tie-bolts for ease of maintenance and bolted to the stub shaft of the compressor. It has an advanced aerodynamic design with a fully 3D-analyzed flow path with cylindrical sections over the first, second stage blades. The airfoils of first and second stage vanes and blades are cooled. The exhaust is either radial or axial.

d) Combustors

Multiple numbers typically 10 nos. of combustors are standard feature in this range of gas turbine. DLN combustor with less than 25 ppm NOx has been envisaged for this project.

e) Generator

The driven electric generator will be connected to the gas turbine shaft through gear box.

f) Heat and Noise Attenuation

The “core engine” shall have external insulation for personnel protection to reduce temperature on exposed surfaces and to minimise noise levels within the enclosure. Acoustic enclosure shall be used for the proposed gas turbine generator.

g) Control and Automation

The control system will be built up standard control system as applicable to different manufacturers. These control system will be designed for integration to different DCS system.

h) Gas Detection System

The unit will have a gas detection system to detect gas in the ventilation outlet duct to the gas turbine enclosure, other area like AIFH, GCV, SRV, GCS and metering skid, etc. The gas detectors will sense the gas concentration of the air. The central unit will receive and analyse the signals from the two detectors, carry out any signal treatment required and give necessary alarm.

The central unit located in the control panel will have light diodes and buzzers for alarms. Detection of a high gas concentration will activate an alarm. A high-high detected gas concentration will shut down the gas turbine.

The system will detect gas fuel leakage during all operation modes and standstill. It can only be shut down from the control room. Smoke detections system as required at suitable places shall be provided.

i) CO₂ Fire Extinguishing System

Automatic fire extinguishing system based on Carbon Dioxide purging is a standard feature for fire protection purpose.

j) Starting System

Typical starting system for this type of machine is either diesel generator (DG) based or static frequency based or starting motor based. At the Uran complex no additional margin on power in existing DG set is available for black start of proposed gas turbine. The gas turbine generator shall have on board DG based start up system like the existing gas turbine generators.

k) NO_x Control

DLN combustor with typically as low as 9 to 25 ppm NO_x is also available for many this class of gas turbine. However some gas turbine model is having only conventional combustor with wet NO_x control system (steam/ DM water injection). Gas turbines with both the types of NO_x control system are in operation in several installations. DLN system of combustor shall be preferable for this project.

l) Mist Eliminator

The mist eliminator is standard feature of this class of gas turbine and the same shall be provided.

m) Inlet Air Filter

Pulse jet (self cleaning filters) is commonly installed. In line with existing gas turbine inlet filter system, high-efficiency pulse jet filters to be installed and material of constructions of all metallic components shall be stainless steel.

n) Online oil cleaning system

Centrifuge based portable oil purification system are optionally provided as per the requirement of Gas turbine oil purification.

o) Online & Off Line Gas Turbine Compressor Cleaning System

The online water wash reduces the compressor fouling. For online water wash DM water is used and gas turbine continues to produce power during water wash. However this is not very effective in removing the compressor fouling. For this offline water wash is resorted. During off line water wash the gas turbine is desynchronized and used to rotate in slow speed and specific chemical solution is injected to gas turbine compressor for cleaning. This restores compressor performance and hence GT output.

p) Heat Recovery Steam Generator (HRSG)

The Heat Recovery Steam Generators shall be of natural circulation, single drum and single pressure type. It shall have supplementary firing. Economisers shall be non-steaming at all loads and turndown. MP steam will be generated in HRSG. The burner shall be ultra Low-NOx type.

Make up water heater (MUH) to be provided in each HRSG. It is to be ensure that

- Metal temperatures of the MUH shall be maintained minimum 50 C above acid dew point under all conditions.
- There shall be no steaming inside the make-up water pre-heater section even at low flow and lowest turndown condition.

Only seamless tubes shall be used. First few rows of the tubes shall be plain tubes and rest of the tubes shall be finned. The design of HRSG shall ensure minimum pressure drop through the HRSG and the flow through the stack. Steam drum shall be designed with minimum 2 minutes of capacity of storage between normal water level and drum dry level.

Necessary dosing System including unloading, storage etc. of chemicals at various points to maintain BFW and boiler water quality, which is required, finally to ensure the desired steam purity shall be provided. Continuous on-line stack monitoring system consisting of sampling probes, piping, analysers, etc. for analysis of SOx, NOx, UHC, CO & SPM shall be provided on the main stack of HRSG. The analysers and recorder shall be located in a suitable air conditioned enclosure near the stack. Blow down from HRSGs shall be collected in pit after being quenched with service water to 60° C.

The diverter damper shall be electrically operated. For complete isolation there shall be one electrical Guillotine damper downstream of diverter damper.

Separate HP chemical dosing systems shall be provided for each HRSG. Following on-line analyzer shall be provided in SWAS system:

- ❖ pH, Conductivity, silica analyser at BFW header.
- ❖ pH, Conductivity at condensate inlet to MUH
- ❖ pH, Silica & Conductivity for superheated steam and drum water for HRSG.

q) Process Water System

The existing water shall be used to generate DM water. Currently Reverse Osmosis (RO) based and ion exchange based DM water generation technology is used to produce DM water. Before the water is passed through the DM chain, it is generally pre-treated in sand bed or dual bed filter. The DM water chains generally run for approximately 20 hours a day and regeneration shall be carried out in the rest of the time.

The ion exchanged based technology uses chemical for regeneration and the same is neutralised in DM plant neutralisation pit and then sent to effluent treatment plant. On the other hand with RO technology the RO membranes are regenerated by back wash and the RO reject is also sent to ETP. In both technologies, the DM plant effluent is mixed with other incoming effluents in the ETP. Boiler blow-down is also sent to ETP. Ion exchange based DM technology shall be used for the proposed DM plant. The same technology is already in use in APU DM plant. This will give added advantage in terms of commonality in O&M and inventory. The DM water is stored in one storage tank in addition to the tanks in APU DM plant and this DM water is supplied to process units or to CPP steam water system as per

demand. The DM water in CPP is first deaerated in Deaerator and sent to HRSG. Necessary chemical dosing as per requirement is dosed in process water.

r) Cooling Water System

The Gas Turbine Generator and HRSG with their associated system generally need some cooling water. The cooling water requirement for the system shall be met with existing cooling water network and also one new FRP cooling tower/ fin fan cooler is installed to take care of black start.

s) Condensate Stabilising Unit

As the old and eroded Condensate Stabilisation Unit (vessel V-306, V308) situated in CPP complex will be dismantled, the same shall need to be installed in respective unit (i.e. CSU) producing unstable condensate. As there is a possibility of contamination of condensate in CSU, condensate polishing unit shall also be installed along with condensate stabilization system.

t) Fuel Gas Conditioning Skid

One fuel gas conditioning skid with the capacity to treat the combined fuel gas quantity of GT-4 and GT-1 & 2 shall be installed. This will subsequently enable to spare the existing old and eroded gas conditioning skid for GT-1&2. This fuel gas conditioning skid comprises of 2 x 50% knock out drum, 2 X 100 % coalescer filter and 2 x 100% heater (one steam +one electric type). Metering of Fuel gas flow to individual gas turbine shall be installed adjacent to this skid.

u) Utilities

This new GT HRSG unit requires Instrument Air (IA), Plant Air (PA), Service Water (SW), N2 and Cooling water. The Existing IA, PA, SW and N2 (only intermittent requirement) system in the complex shall take care of the requirement of IA, PA, SW and this quantity is also very small. The proposed GT shall be capable of Black start and for this one FRP cooling tower with one spare shell is to be installed. However the requirement of CW shall be restricted to minimum usage by adopting good engineering practice. Rest of the cooling water requirement shall be met through cooling tower or fin fan cooler. Service Water shall be used for HRSG blow-down water cooling.

2.2.2 Fuel

The plant will be primarily fuelled by “Fuel Gas” available in-house. “Emergency fuel gas” will be the alternate fuel. Diesel will be used as fuel for startup diesel engine. The composition of the gaseous fuel is given in Table 2.2.

Table 2.2: Composition of Gaseous Fuel to be Used

Constituent	Designed Fuel Gas (Normal)	Alternate for Emergency Gas	
		9	1
C1 (%)	96.29	55.75	
C2 (%)	2.42	30.10	
C3 (%)	0.78	-	13.87
i-C4 (%)	0.07	-	-
n-C4 (%)	0.09	-	-

CO ₂ (%)	0.05	0	-
N ₂ (%)	-	1	-
H ₂ O	-	Satur	Saturated
H ₂ S (ppm)	-	-	20
Net CV (Kcal/Sm ³)	8381	-	
Gross CV (Kcal/Sm ³)	9298	-	

The gas consumption in the gas turbine is expected to be 385 Sm³/MWh. The gas consumption in the APU boiler is expected to be 75 Sm³/MT/hr.

2.2.3 Electrical Power System

In the existing plant, the electrical power is generated at 11kV, three phase, 50Hz by the 3 nos. existing GTG (Gas Turbine Generators) (GTG-1&2 rated at 23.8635MVA and GTG- 3 rated at 21.83MW). The details included are for the addition of suitable rated GTG 4 and its other electrical equipments as required.

The existing GTGs generate power at 11kV at 22kV Co-gen bus which is stepped up through 11kV/ 22 kV generator transformers (TR-751 rated at 28MVA for GTG-1, TR-752 rated at 40MVA for GTG-2, TR-753 rated at 28MVA for GTG-3) and connected to 22 kV COGEN bus. The rating of the existing 22kV switchboard is 22kV, 2000A, 26.2kA for 1 sec. The 22kV COGEN bus is further connected to 22kV HBB bus via two 22kV, 40/48MVA series reactors. The rating of the 22kV switchboard at HBB is 22kV, 3000A, 26.2kA for 1 sec. Power from 220kV grid of MSEB is imported and stepped down to 22kV using 2 Nos. 60 / 75MVA 220 / 22kV grid transformers. These are hooked up at 22 kV HBB bus. Auxiliary power for GT auxiliaries at 415V is obtained through 11/0.433kV Unit Auxiliary Transformer (UAT) by tapping from the main run of the cable between Generator circuit breaker and Generator transformer of Gas Turbine Generator (GTG) unit.

The new GTG-4 shall also generate power at 11 kV which shall be stepped up to 22 kV using generator transformer. It is intended to hook up the new generator at 22kV HBB bus instead of hook-up to the 22kV COGEN as is the case with the existing generators.

Since bulk of the power including the new APU is being utilized from HBB and the series reactor rating is limited to 40/48MVA due to constraints of the short circuit level, in order to get maximum advantage and reliability for power evacuation, GT-4 shall be connected to the 22kV HBB bus. The auxiliary power (415V) for unit auxiliaries shall be obtained through UAT as followed in the existing electrical system.

During normal operation, all four generators would be running and grid shall be connected at the 22kV HBB bus with HBB bus coupler NO. Preliminary power system studies were carried out on E-TAP software and following were the broad observations for the same:

- The short circuit rating of existing 22kV switchboards at COGEN as well HBB is not found adequate. With addition of new generator the short circuit rating of 22kV switchboard both at COGEN as well HBB shall exceed the existing rating. Based on the report outputs, both switchboards are to be replaced by 22kV, 2500A, 40kArms/ 100kA (peak) for 1sec GIS.
- The existing series reactors with new generator connected to HBB bus are found to be of adequate and the same shall be retained with new GIS.

The major electrical equipment envisaged for the project are:

- Electrics for GT-4, generator transformer, Unit Auxiliary Transformer, Cabling, lighting etc.
- Synchronising panel, relay & protection panel for GT-4 and generator transformer
- 22kV, 40kA GIS switchgears at COGEN and HBB. 22kV, 40kA GIS isolator breaker panel.
- Adequately rated 22kV cable shall be laid between generator circuit breaker (GCB) at CO-GEN substation and 22kV HBB bus.
- New 22kV bus duct/ cable shall be provided between grid transformers and the 22kV HBB bus.
- Cable joints shall be provided in existing power & control feeder cables in existing 22kV panels at COGEN & HBB to facilitate their termination at new 22kV GIS at both the substations.

- The electrical equipment for the project shall be installed in the following substations:

22kV GIS at CO-GEN shall be installed in the switchgear room for the existing main substation at CO-GEN after dismantling the existing 22kV switchboard.

Generator Circuit breaker and UAT Circuit breaker shall be installed in the switchgear room in the existing CO-GEN substation.

- All electrical control, synchronizing and annunciation equipment shall be installed in the existing control room building in CO-GEN. It is proposed to extend this building to accommodate the control system equipment for new GTG.
- All GT aux 415V, MCCs, PCCs, LDB, ASB and UAT shall be accommodated in the new GTG switchgear hall.
- Generator transformer shall be accommodated in the transformer bay near the new GT switchgear hall.
- 22kV GIS at HBB shall be installed in the existing switchgear room in HBB by dismantling the existing 22kV switchboard.

For emergency power requirement of the entire project & during blackout condition, emergency 415 V power supply from existing EPMC shall be provided for black start of the GTG and to feed all the essential loads and for safe shutdown of the units.

Motors rated up to 160 kW shall be connected to 415 V bus and motors of rating above 160 kW shall be connected to 6.6kV bus. MV motors up to 55 kW will be fed from Motor Control Centres (MCCs) whereas; motors rated above 55 kW and up to 160 kW shall be fed from Power Control Centres (PCCs).

415V PCCs shall be provided with Auto/manual transfer arrangement between the two incomers and bus coupler. Normal, emergency and DC critical lighting has been envisaged for the plant.

The lighting loads of the newly added buildings, equipments and areas shall be fed through lighting Distribution Boards (LDBs) connected to 415/415V lighting transformers which draw power from 415V switchboard. 20% to 25% of plant lighting shall be on AC emergency. Emergency lighting load shall be fed through suitable nos. and rated emergency lighting feeders (to be provided by Client) which in turn shall get feed from Emergency Lighting Distribution Boards (ELDBs) having supply through 415V/415V Emergency lighting transformers.

Auxiliary Service Boards (ASBs) shall be provided to feed new power panels, welding receptacles, miscellaneous loads etc, as required.

To provide uninterrupted power supply to DCS and other Control Panels, a dedicated 110V AC UPS system shall be provided. To feed GTG essential loads, such as the emergency oil pumps 125V DC system shall be provided. For the control Supply to Switchgears / Panels, Emergency DC lighting etc, 110 V DC supply backed by DC Batteries shall be provided.

Voltage Levels in the power plant shall be as follows:

- ❖ Power evacuation : 22kV (+10%,-10%), 3 phase, 3 wire, 50Hz
- ❖ Generation Voltage : 11kV,3phase,50 Hz
- ❖ Plant LT Auxiliary Supply : 415V ($\pm 10\%$), 3 phase, 4 wire, 50Hz
- ❖ Plant DC Supply: 110V ($\pm 10\%$), DC 2 wire.
- ❖ DC system for GTG-4 : As Required
- ❖ Plant UPS Supply: 110 ($\pm 10\%$), 1 phase, 2 wires 50 Hz, A.C.
- ❖ Voltage level for AC Motors: 240 V, Single phase, 50 Hz, with DOL start. Below 0.2kW
- ❖ Voltage level for AC Motors: 415 V, Three phase, 50 Hz, with DOL start. From 0.2kW to 160kW.

Electrical equipment and components shall be designed in accordance with applicable Indian Standards and shall conform to statutory regulations.

2.3 PROPOSED ENHANCED REACTIVE THERMAL OXIDIZER (ERTO) PLANT

ONGC Uran Pant is processing 11.5 MMSCMD of Natural Gas from Mumbai Offshore and produces approximately 3800 TPD of Value Added Products (like LPG/C2C3 & Naphtha) from Natural Gas & Associated Condensate contributing to the national exchequer. It has been observed that the average concentration of H₂S in natural gas feed to Uran plant is 118 ppm. For mitigation of H₂S, from Acid gas, Uran plant studied various technologies and finally selected ERTO process as per recommendation of NEERI, Nagpur as detailed below:

Various technologies available in market are not viable for Uran plant, as sulphur load and other parameters are not matching the requirement of other processes. For seeking a suitable technology for H₂S mitigation for Uran plant, National Environmental Engineering and Research Institute (NEERI), Nagpur was engaged for feasibility study of H₂S mitigation. After detailed study, NEERI has recommended Enhanced Reactive Thermal Oxidizer (ERTO) plant, which is most suitable for Uran plant and a proven technology for H₂S mitigation.

2.3.1 Process description:

The Process philosophy of proposed ERTO are consisted of:

- ❖ Oxidization of hydrogen sulphide (H₂S) from acid gas to SO₂ with the help of ERTO.
- ❖ Conversion of SO₂ to brine solution of Sodium Sulfite (Na₂SO₃) with the help of wet alkaline scrubber (Caustic solution, NaOH).
- ❖ Purifying the tail gas, for venting into the atmosphere (as per CPCB/MPCB norms).
- ❖ The liquid effluent (quantity <100 m³ per day), mainly brine solution of Sodium Sulfite (Na₂SO₃), shall be diluted with existing treated water (~ 3000m³ per day) from effluent treatment plant and finally discharged into sea (complying MPCB standards). Sodium Sulfite (Na₂SO₃) being white colored salt solution and all

parameters like BOD, TSS, PH shall be maintained as per MPCB norms, before discharging to sea, hence there shall be no adverse impact on Sea water. MPCB vide their Consent order No :- Formate1.0/ BO/CAC-Cell/ UAN No 11474/1st CAC dated 17.04.2017 has accorded consent to ONGC Uran plant to dispose treated effluent into sea. The consent limit for treated effluent discharge is 9000 m³/day as per MPCB Consent.

It has high scalability in plant operations and is designed to handle Acid gas flow from 0.4 MMSCMD to 0.133 MMSCMD. Space requirement is also less compared to other technologies as Uran Plant has acute space constraint.

Note: Natural Gas Sweetening is not a common process and in India there are only two to three such plants using the Natural Gas Sweetening process. Hence, this makes it a niche area of technology. The selection of the H₂S handling process is unique to the feed to the Unit and varies from process to process. Many critical factors such as the concentration of H₂S in the acid gas, quantity of acid gas generated the ease of handling the by-products of the Acid Gas removal process are crucial to selection of the process. The selection of ERTO was made after meticulous consideration of all such aspects, in consultation with NEERI.

2.3.2 Proposed Configurations

ERTO plant involves treatment of 400,000 SCMD of acid gas containing up to 5000 ppm of H₂S, on the east side of the GSU area. Enhanced Reactive Thermal Oxidization is followed by alkaline scrubbing technology so that the sulphurous constituent generated after oxidation of Acid Gas is converted to Na₂SO₃ (Sodium Sulphite).

The proposed ERTO plant has the following sections,

- a. Thermal Oxidation of Acid Gas
- b. Heat recovery system
- c. Wet alkaline scrubbing system
- d. Venting through stack

The ERTO plant load is based on the generation of Acid gas after treatment of natural gas in the Gas sweetening units (GSU – 12, GSU-13 & GSU-14) of Uran Plant.

2.3.2 Process Description

A) Burner, Thermal Oxidizer and Heat Recovery Unit

The acid gas generated from the GSU units is the feed for the Thermal oxidizer of the ERTO plant. The base design parameters and characteristics of the feed gas (acid gas) to the proposed Plant are given below in Table – 2.4.

Table-2.4: Design parameters and characteristics of the feed gas (acid gas)

DESIGN BASIS (ERTO)	
COMPOSITION (mole %)	NORMAL (OPTIMIZED)
C1	1.13
C2	0.35

C3	0.21
iC4	0.04
nC4	0.02
N2	0.32
H2S	0.4
CO2	97.53
Total	100
Flow rate (SCMD)	400000
Pressure (psig)	3-5
Temperature (°C)	35-40
SO2 content in clean tail gas	< 200 mg / Nm3 of SO2

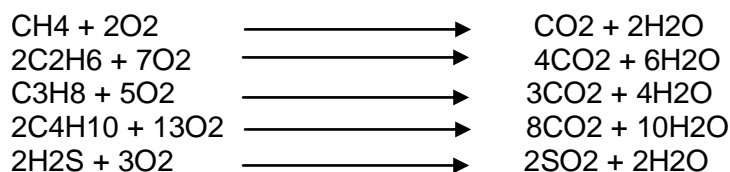
The acid gas from three GSU units (approximately 350 meters away from ERT0) is fed by a single header to the knock out drum in the ERT0 plant. The acid gas knock out drum is a part of the ERT0 plant for removal of any carried over amines and water knock out and is connected through a closed drain system to the existing Chemical Sewer system of GSU. The acid gas is further added into the Heat recovery unit where it recovers the heat from the hot gases coming from the thermal oxidizer. The acid gas from the elevated temperature is fed into the pre-heated thermal oxidizer, where the gas gets completely oxidized in presence of excess combustion air fed through a combustion air fan into the thermal oxidizer.

Fuel gas (Natural Gas) is used for initial startup and as required for heating of the thermal oxidizer. Low NoX Burner is installed for complete combustion of Acid Gas. The main burner body is designed for perfect mixing of combustion air, fuel and acid gas. Low NOX emission is achieved by controlling the amount and ratio of air and a controlled flame temperature profile. The burner management system (BMS) along with UV Flame scanner is provided. The flue gas from the Thermal oxidizer is fed to the heat recovery system at a temperature of approximately 850°C. The acid gas from the knock out drum at ambient temperature enters the heat recovery unit to recover the heat from the flue gas called as hot acid gas and is fed to the thermal oxidizer.

In the Thermal Oxidizer, combustion zone is divided into two areas, separated by a mixing wall. During stand-by operation the first zone is maintained at 650 to 850°C with minimal fuel consumption. When in operation the temperature in the first zone is controlled to 850-1250°C whilst off-gases are injected tangentially in the first chamber through a ring-main around the combustor casing.

Complete combustion is ensured by the proprietary burner design which provides the required level of turbulence to have a good mixing of combustion air, fuel gas and acid gas while maintaining flame stability. The combustion chamber is equipped with static mixing provisions to provide turbulence and mixing of the combustion gases and remaining (secondary) combustion air. After passing through the mixing wall the gases are maintained at a temperature between 850°C and 950°C to assure complete combustion. The flue gas coming out from the heat recovery unit is at a temperature of about 488°C. The complete oxidation of acid gas leads to the formation of Sulphur dioxide.

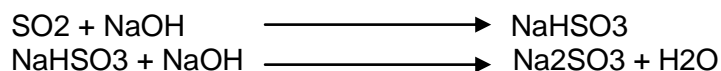
Typical Oxidation Reactions



B) Quencher, Scrubber and Stack

The flue gas is then fed to the Quench tower and is cooled using quench water. The quench water absorbs the heat from the flue gas and the gas is fed to the wet alkaline scrubber. The quench tower is installed in a vertical arrangement before the scrubber inlet. A collar made of haste alloy will be the part of top portion of the quench tower where the hot gas contacts with water. A liquid film is created inside the quench to protect the body. The flue gas from the quench is cooled down from 488°C to below 70°C

Typical Scrubber Reactions



The flue gas passes through the scrubber and is treated before discharge. In the scrubber the flue gas comes in contact with the caustic solution lye and is scrubbed to clean gas. The scrubbing liquid is recirculated to minimize water consumption and thus minimizing the operating cost. The scrubber recirculation pump draws the liquid from the collection tank to the main discharge headers. At the main discharge header, a network of discharge nozzles ensures that the liquid is sprayed equally over the spray tower.

Caustic storage tank is provided with a storage capacity of 10 days. Also a day tank is provided with a capacity of transfer for caustic solution for minimum 8 hours through a dosing pump. The flue gas after absorption passes through a demister where the liquid droplets are captured and collected back in the collection tank.

To ensure maximum efficiency, pH of the scrubbing liquid is measured and controlled continuously via pH measurement. The sodium sulphite concentration has to be limited to prevent buildup up in the scrubbing liquid, thus decreasing the absorption capacity of the scrubbing liquid. The sodium sulphite concentration is controlled by blow down line. The addition of makeup solution is controlled automatically via a solenoid valve and level controller. Effluent generated from the scrubber mainly Na₂SO₃ is diluted with existing treated effluent from ETP and finally to be discharged into sea.

2.3.3 Specification of effluent from ERTO

The SO₂ content in the clean gas is less than < 200 mg/Nm³. The clean gas is extracted using extraction fan and vented through 50m stack. Also the H₂S content in ambient air at ground level is monitored to be < 0.1 ppm.

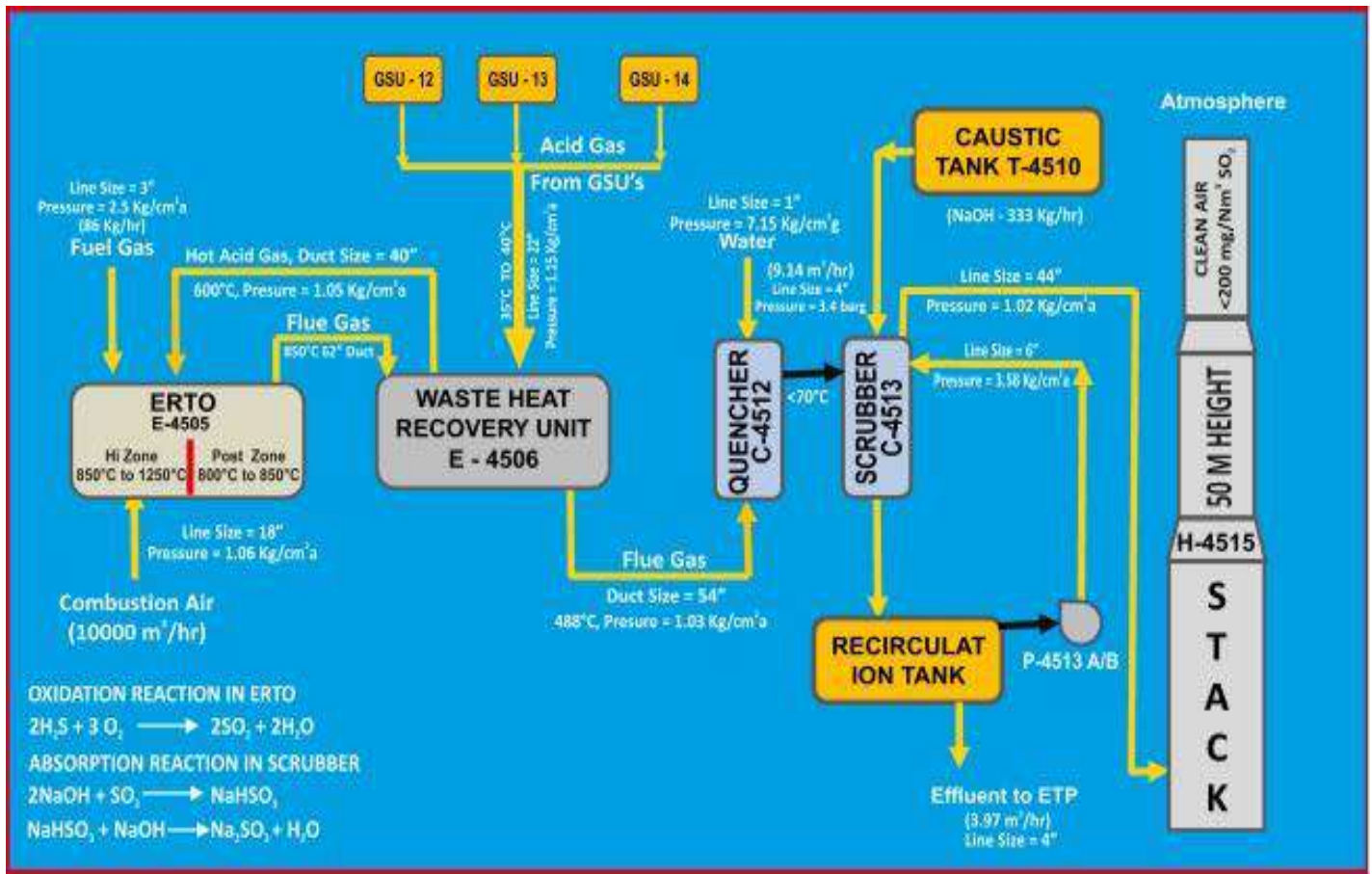


Fig.2.5: Process Flow Diagram of proposed ERTO Plant

2.4 PROJECT SERVICES AND UTILITIES

2.4.1 Water

The plant requires water for process steam, steam for power generation, cooling, dust suppression & equipment washing, utilities, plant drinking water and irrigation of green belt & plantations. Water is supplied by Maharashtra Industrial Development Corporation (MIDC). ONGC has an agreement with MIDC for supply of 16500 m³/day of water. ONGC is also setting up a 20,000 m³/day capacity sea water desalination plant. The present supply is sufficient to meet its present and immediate future requirements.

The present and future water demand and sources are given in Table 2.3.

Table 2.3: Water Requirements of the Uran Plant

Purpose	Quantity	Source(s)
EXISTING		
Process		
1. Cooling Tower Makeup	13085	Supplied by Maharashtra Industrial Development Corporation (MIDC)
2. Soft water makeup for steam generation & other processes	2465	
Services		

Gardening, Construction, fire services etc.	850
Drinking	100
Sub-Total	16500
<i>All figures in m³/day</i>	

The new GT-IV will not require any additional water. The existing Thermax Boiler will be scrapped. The water being utilised by this boiler, will now be consumed by the proposed unit. The proposed ERTO unit will require ~220 m³/day of raw water in the Quencher section as shown in the ERTO PFD. However, the raw water demand of the complex shall be well within the consent limit of 16500 m³/day. The water demand is illustrated as Fig. 2.6.

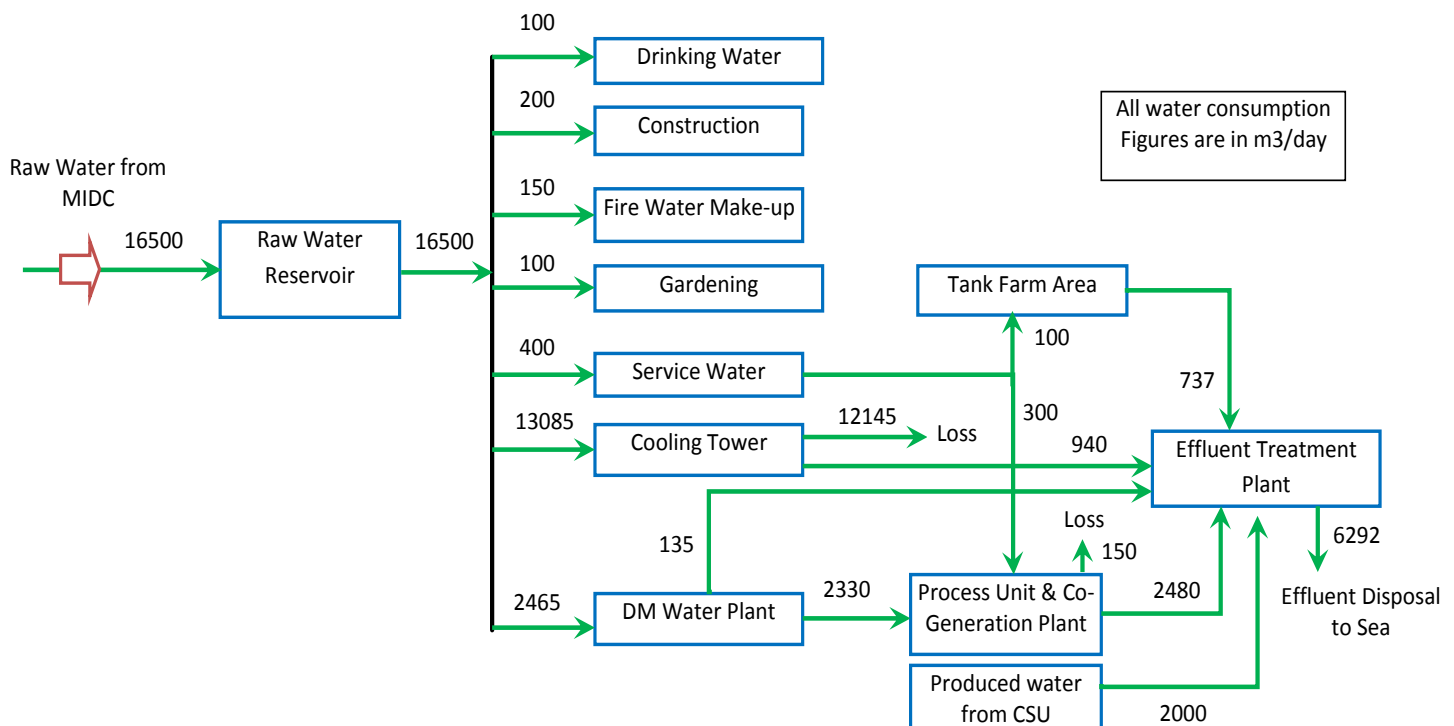


Fig.2.6: Water Balance diagram of Uran Oil & Gas Processing Plant (Post GT-VI & ERTO project scenario)

ONGC has townships for its employees at Uran and Panvel. The Uran township has 142 dwelling units, while the Panvel Township has 1415 dwelling units. The Uran township houses only Central Industrial Security Force (CISF) personnel. These townships have all amenities for its employees. The plant's main hospital is located at the Panvel Township. Arrangements are in place with super specialty hospitals in Navi Mumbai and Mumbai city for treatment of serious cases. During construction, the average temporary manpower requirement is 50 people during first year and 100 people during second year & third year. During operation phase, approximately 10 persons directly and around 30 persons indirectly are envisaged.

CHAPTER-3 EXISTING ENVIRONMENTAL STATUS

3.0 DESCRIPTION OF ENVIRONMENT

3.1 INTRODUCTION

This chapter illustrates the description of the existing environmental status of the study area with reference to the prominent environmental attributes. The study area covers the area falling within 10 km radius around the proposed project area.

The existing environmental setting is considered to adjudge the baseline environmental conditions, which are described with respect to climate, land use, atmospheric conditions, water quality, soil quality, noise levels, vegetation pattern, ecology, and socio-economic profiles of people. The objective of this section is to define the present baseline environmental status within the study area. This would help in assessing the environmental impacts due to the proposed project.

This report incorporates the baseline data monitored during March to May, 2017 representing Summer season based on TOR. Sampling and analysis for ambient air quality, noise levels, water quality and soil quality has been carried out by the Environmental Engineering Laboratory of MECON Limited. Land use and land cover studies were carried out by M/s Apex Spatial Tech Solutions Pvt. Ltd. under the supervision of concerned NABET accredited Functional Area Expert of MECON Limited. Marine ecological studies have been carried out by M/s Lotus Granges (India) Ltd., Mumbai under the supervision of concerned NABET accredited Functional Area Expert of MECON Limited. Secondary data collected from various Government and Semi-Government organizations is also included in this chapter.

3.2 CLIMATE

The study area lies in tropical region where climate is characterised by hot summers and mild winters.

The IMD observatory nearest to the project site is at Colaba, Mumbai, about 12 km West-North-West of the project site.

Summer is typically from March to May when temperature ranges from a mean daily maximum of 33.4°C to mean daily minimum of 22.7°C. Winter is from December to February when temperature ranges from a mean daily maximum of 31.4°C to mean daily minimum of 19.3°C. The mean annual rainfall is 2146.6 mm (average of 75.9 rainy days per year). The South-west monsoon lasts from June to September and the area gets ~95.7% during this period. July is wettest month (mean monthly rainfall of 750.4 mm; 22.0 rainy days) followed by June (583.6 mm, 15.4 rainy days) and August (460.9 mm; 20.8 rainy days).

As per IMD Colaba records (Ref. Climatological Data Tables, 1951 – 1980; Published by IMD, 1999), the annual predominant wind directions are North- west, West and south-west,

prevailing for 26%, 23.5% and 10% of the time respectively. Calm prevailed 4.5%. During the Summer Season months the predominant wind directions are North-west, West and North, prevailing for 33.8%, 21.1%, and 12% of the time respectively whereas Calm prevailed 5.7% of the time.

3.3 GEOLOGY AND GEOHYDROLOGY

3.3.1 Geology of the region

The plant is located at Uran, Raigad district and it falls in the coastal alluvial tracts near to the coast of Arabian sea. The geology of the entire district consists of dark-coloured volcanic lava flows and laterites. The lava flows were poured out of the long and narrow fissures in the earth's crust, at the close of the Mesozoic era, approximately, 80 to 100 million years ago. These are spread out in the form of horizontal sheets or beds and constitute the innumerable spurs, hills and hill ranges; bold, flat topped ridges; lofty peaks and plateaus with impressive cliffs. These hill ranges and plateaus form a part of the famous Western Ghats.

Magnetite is the most common accessory mineral though, at times, a fair amount of olivine is also present. The basalts are usually dark grey to grey and bluish grey in colour and are hard, compact and tough and fine to medium grained in texture. Next to this common variety of trap is found the comparatively softer, amygdular and scoriaceous traps, purple to greenish in colour, usually showing rounded and elongated or tubular cavities and geodes with infillings of secondary minerals like calcite, zeolites and a variety of secondary quartz like agate, jasper, chalcedony, etc.

Beds of laterite, usually formed by the mechanical and chemical disintegration on the underlying trap are found in these regions. The beds vary in thickness from five to 50 feet or more.

3.3.2 Geology of the Project Area

The sub surface geology is revealed by the study of lithological logs of boreholes drilled in the plant area. From Soil investigation report, it can be seen that a thin sequence of unconsolidated brown clayey silty sand and clay are present below the soil cover. Grayish brown silty fine sand forms the strata beneath the sandy & clayey silts. Weathered rocks & hard rocks have been encountered in all bore holes at depths ranging from 3m to 4m. The thickness of the individual layers varies from 1.2m to 1.8m. Predominantly the subsurface layer is silty sand & clay up to a depth of 3m.

3.3.3 Geomorphology

3.3.3.1 Regional geomorphology

Raigad district has three physiographic divisions i.e. (i) Coastal zone in west covers about 20% percent of the district (ii) Central zone covers about 1/3 rd of the district, consisting of fertile land in low lying area (iii) Hilly zone in the eastern part highly uneven in altitude and covered with forest. This hill range is characterized by ruggedness and uneven topography, with crestline of peaks and saddles forming the eastern horizon. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river. The soils in the district are formed from the Deccan Trap which is predominating rock formation with small out crops of Laterite at a few places in the Poladpur taluka and Matheran hill.

3.3.3.2 Site Specific Geomorphology

The proposed site falls under the coastal plains of depositional landforms of recent origin and geologically belongs to the Post- tertiary period with moderate soil cover. The low relief areas contain coastal plain and valley fill. The higher areas consist of low dissected plateau/pediments and the top most high mountain regions.

3.3.4 Soil characteristics

There are four types of soil observed in the Raigad district namely:

- (a) Alluvial soil.
- (b) Powdered laterite and clay soil.
- (c) Clayey mould resting on trap.
- (d) Soil containing marine deposits with much sand and other matter in concretion.

Alluvial soil comprises of various disintegrated rocks of the overlying trap formation, with a varying proportion of calcareous substances. It is red, yellow or black in colour, crumbly, and, from the drainage of hill streams, free from salt. Of the three colours all are equally productive, but the black is most suited for growing-rice. Its richness is due chiefly to its lime nodules or kankar, and to the vegetable matter in valleys and near river banks.

Powdered Laterite and clay soil covers the sides and slopes of hills. Though fitted for the growth of such hill crop as nachni, vari, harik, udid, this soil, owing to its shallowness, soon becomes exhausted.

Clayey mould resting on trap is found near the banks of the Nagothane, Roha and Mandad creeks, and in the strip of land that stretches from Dasgaon ten miles west along the sides of the Savitri river. In the strip of land that runs by the side of the

Nagothne creek, about eighteen miles long and from half a mile to three miles broad, the soil is mixed with chalky tubes locally called ladh. Some detached flats of this soil along the Roha and Mandad creeks are cultivated for inferior rice. The third is very dark brown, in colour and when dry, it is extremely hard. In places where it is or was liable to be flooded from creeks and backwaters it is called kharepat or salt land.

Soil containing marine deposits with much sand and other matter in concentration lies along the sea-coast and is favorable to garden crops, which are helped by the abundant supply of water contained in a belt of concrete and lime.

3.3.5 Geohydrology

Raigad district is predominant by Deccan trap basalt of upper cretaceous to lower Eocene and intruded by a number of dykes. The western part of the district consisting of basalt flows are altered to laterite. Recent deposits comprising beach sand and alluvium occur along the coast and in the river mouth; however they do not form potential aquifer. In hard rock areas i.e. Deccan trap, ground water occurs mostly in the upper weathered and fractured parts down to 10 – 15m bgl under unconfined condition. The water bearing strata at deeper depth exists under semi confined to confined conditions. The dug wells in these areas show rapid decline in water level during post monsoon period and practically go dry in peak summer. In foot hill zones the water table is relatively shallower near water course. The yield of dug wells tapping upper phreatic aquifer ranges between 45 to 60 m³/day, whereas that of bore wells varies from 0.50 to >20 m³/hr. depending upon the local hydro geological conditions, however in most of the bore wells, it is up to 5 m³ /hr. In the alluvial deposits, primary porosity is high due to the inter-granular pore spaces thus, enabling the percolation of water through the soil. The ground water occurs under phreatic/unconfined aquifer at relatively shallow depths of 3-5 m and their yield ranges from about 18 to 43 m³/hr.

Groundwater condition

Ground water occurs under phreatic/unconfined aquifer at relatively shallow depths of 3-5 m and their yield ranges from about 18 to 43 m³/hr in the beach sand/alluvial area. In hard rock areas i.e. Deccan trap, the ground water occurs mostly in upper weathered and fractured parts down to 10 – 15 m bgl under unconfined condition. The water bearing strata at deeper depth exists under semi confined conditions. The dug wells in these areas show rapid decline in water level during post monsoon period and practically go dry in peak summer.

During course of the study, 13 dug wells were inventoried in the plant water shed (10 Km radius). The water levels of the open well were measured. The measured water tables during the study period are given in the **Table 3.1**.

Table 3.1: Measured water tables during study period

Name of the Village	Total Depth (m)	Water level (m)	Reduced level (m)	Dia. (m)	Type of aquifer
Kharkhand	6.5	5.77	9	3.6	Coastal region
Vanvatti	8.8	1.3	7	5.3	
Danda	6.5	3.4	8	3.5	
Ranvad	7.7	7.1	12	4.3	
Kegaon	7.3	7.5	12	4.3	
Aveda	8.5	2	8	5.4	
Nagaon	7.4	6.2	10	3.8	
Mulekhand	10.2	2.7	11	3.3	
Chanje	6.4	4.7	9	3.8	
Balai	3.5	5.5	8	5	
Chanje	6.4	4.4	9	3	
Karanja	6	2.7	7	2.5	
Kodhripada	7.1	2.1	5	4.3	

From the table, it is evident that the water table in coastal region ranges between 1.3m to 7.5m. The measured water levels in these regions are in line with the data reported by CGWB. The depth of the open wells in this area varies from 6m to 10.2m bgl and the depth of water level varies between 1.3m to 6.2m depending upon the topography of the area. The plant area, which lies in the low lying alluvial region, has potential of groundwater.

3.4 PHYSIOGRAPHY AND DRAINAGE

The project area is entirely within an existing Oil & Gas Processing Plant (an industrial plant). The area within 10 km radius consists of flat coastal plains and hills which form part of the Western Ghats. The Uran Plant itself is located at the tip of a peninsula formed by the Karanja Creek in the south-east, the Dharmatar Creek in the south, Thane Creek / Mumbai Harbour in the north and the Arabian Sea in the west. On the Plant's eastern boundary there is a steep hill / ridge, "Dronagiri Hill", which rises up to 280 m above mean sea level (a.m.s.l). The Dronagiri Hill stretches for a length of about 2 km in the north-south direction. There is another steep ridge ~2.5 km north-north-west of the Uran Plant. This ridge's maximum height is 171 m a.m.s. land its area is much less than Dronagiri Hill. There is another escarpment 8.3 km south of the plant across the mouth of the Dharmatar Creek / Karanja creek. The rest of the area is flat. There are some marshy areas along the banks of Dharmatar Creek as well as Karanja Creek. These marshy areas are covered with mangrove vegetation.

As mentioned above there are three major drainage channels in the study area. (Thane Creek, Dharmatar Creek and Karanja creek). Of these, the part of the Thane Creek within the study area is a wide estuary which forms the Mumbai Harbour. There are also several small creeks which flow into these large creeks. All these creeks are tidal in nature. Several drainage channels flow down from the escarpments located in the study area. The drainage channels which flow towards the west directly drain into the Arabian Sea. The others empty into other larger channels which in turn join one of the tidal creeks. The drainage in the immediate vicinity of the plant is shown in Fig. 3.1. The area does not fall in a land slide prone zone. The area falls in "Moderate Risk Seismic Zone" (Zone III).



Fig. 3.1: The drainage map of the Study area

3.5 LAND USE

3.5.1 Objectives of the Land Use study

The main objectives of land use studies are:

- Establishing the existing land use pattern in the study area;
- Analyzing the impacts of the proposed project on the land use pattern of the study area; and
- Making recommendations for optimization of the future land use pattern in the study area in view of the proposed project and its allied activities and their associated impacts.

The land use pattern in the study area has also been established through the interpretation of the Satellite Imagery.

Land use in the project area

As mentioned earlier, the proposed project being set up within the existing industrial plant complex. At present a packaged boiler plant is located in the area (see Fig. 2.3) which will be dismantled & scrapped.

Land use in the study area

Land Use/Land Cover (LULC) pattern for ONGC Uran project (10 km radius from the project site) was studied by analysis of satellite data path/row of 105/059 B of IRS P6 LISS- IV (5.8 m) December 29, 2014. The study was limited to mapping the spatial distribution of the present land use/land cover, drainage, water bodies and Digital Elevation Model (DEM) with respect to site and 10km study area by using satellite remote sensing data, image interpretation techniques, topographic map and ground surveys.

The general elevation of the study area ranges from sea level to 290 m above the mean sea level. The project area falls in the coastal origin - younger coastal plain. The study area is characterized by structural, denudational lower pediment, coastal alluvium, riverine alluvium landforms with various land use categories. Satellite image data pertaining to the area was used in this study to derive details about the land use/land cover.

Existing land use in the study area is shown in **Table 3.2**.

Table 3.2: Land use in 10 km Radius Area

Sl. No.	Land use category	Area (ha)	Percentage
1	Sea	15784	50.25
2	Agricultural Land	3370	10.74
3	Plantations	844	2.69
4	Agricultural Land (currently fallow)	39	0.12
5	Urban Settlements	291	0.93
6	Rural Settlements	615	1.96
7	Industrial Land	807	2.57
8	Land with Scrub	1734	5.52
9	Land without Scrub	1146	3.65
10	Forest	109	0.35
11	Barren / Uncultivable / Waste Land / Sandy area	1732	5.51
12	Swamp / Mangroves	1952	6.21
13	Wetlands / Water bodies / coastal wetlands	1984	6.32
14	Natural Lakes & Ponds	143	0.46
15	Man-made lakes / ponds	160	0.51
16	Creeks	299	0.95
17	Rivers / Canals	4	0.01
18	Others	400	1.27
	TOTAL	31413	100

The table shows that 50.25% of the study area consists of sea; Settlements occupy about 2.9% of the study area; Industries occupy ~2.6% of the study area; Wetlands / Water bodies / coastal wetlands occupy ~6.3% of the study area; Swamps & mangroves occupy ~6.2% of the study area; Other inland water bodies occupy ~1.9% of the study area; Scrub lands occupy ~5.5% of the study area; Barren / Uncultivable / Waste Land / Sandy areas occupy ~5.5% of the study area; Forests occupy only 0.35% of the study area. Land cover of the study area is shown in Fig. 3.2.

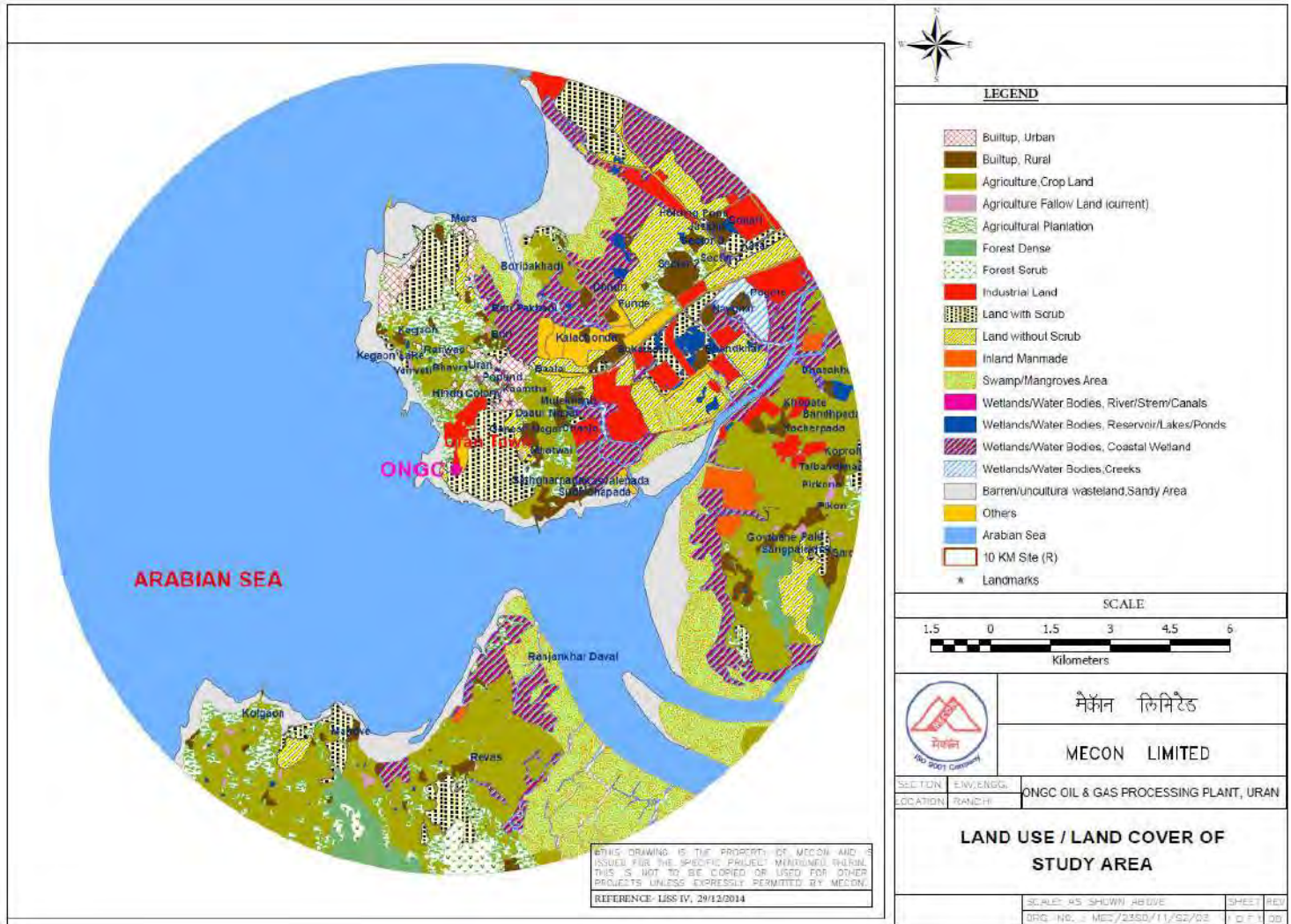


Fig. 3.2: Land Use / Land Cover of Study Area

3.6 AIR ENVIRONMENT

Dispersion of different air pollutants released into the atmosphere have significant impacts on the neighborhood air environment of an industrial project and forms an important part of impact assessment studies. The ambient air quality status with respect to the study zone of 10 km radial distance from the plant site will form the base line information over which the predicted impacts due to the proposed expansion plant can be super imposed to find out the net (final) impacts on air environment. From the final impacts a viable Environmental Management Plan (EMP) can be prepared based on the impact statement for the air environment. The baseline status of the ambient air quality can be assessed through scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance program has to be based on the following considerations.

- Meteorological conditions on synoptic scale
- Topography of the study area
- Representation of regional background levels
- Representation of plant site
- Representation of cross sectional distribution in the downward direction
- Influence of the existing sources if any, are to be kept at minimum
- Inclusion of major distinct villages to collect the baseline status

3.6.1 SELECTION OF AAQ STATIONS

A systematically designed air quality surveillance programme forms the basis for impact assessment on air environment due to proposed project activities. The basic consideration for designing such a programme includes representative selection of sampling locations, adequate sampling frequency, duration of monitoring and monitoring of all relevant and important pollution parameters (NAAQS, 2009). To quantify the impacts due to proposed project on the ambient air quality, it is necessary at first to evaluate the existing ambient air quality of the study area. The existing ambient air quality, in terms of Respirable Particulate Matter (PM₁₀ and PM_{2.5}), Sulphur-dioxide (SO₂), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Ozone (O₃), Ammonia (NH₃), Lead (Pb), Arsenic (As), Nickel (Ni), Benzene (C₆H₆), Volatile Organic Carbons (VOCs) and Benzo(a)Pyrene (BaP) has been measured through a planned field monitoring.

A network of Eight ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone (Fig. 3.1). The heights of the sampling locations were kept between 3 to 6 m in all the locations. The distance of each monitoring station with respect to project site is mentioned in table 3.3.

After reconnaissance of the area and observing the topographical features and review of the available meteorological data and local conditions the sampling sites were chosen which will be the representative of the local areas under study.

The selected stations are given in **Table 3.3**. They are also marked in Fig. 3.3.

Table 3.3: Ambient Air Quality (AAQ) Monitoring Stations

Sl. No.	Locatio	Stn. Code	Latitude	Longitude
1.	Village Nagaon	A1	18°52'25.6"N	72°55'39.9"E
2.	Village Pirwadi	A2	18°51'30.2"N	72°55' 25.8"E
3.	Village Daurnagar	A3	18°52'25.1"N	72°56' 24.2"E
4.	Village Karanja	A4	18°50'51.1"N	72°56' 40.8"E
5.	ONGC Plant Main Gate	A5	18°52'25.6"N	72°56' 0.1"E
6.	Village Kegaon	A6	18°52'53.6"N	72°55' 36.9"E
7.	Village Funde	A7	18°53'24.3"N	72°57' 49.8"E
8.	Village Mora	A8	18°53'51.4"N	72°55' 51.8"E

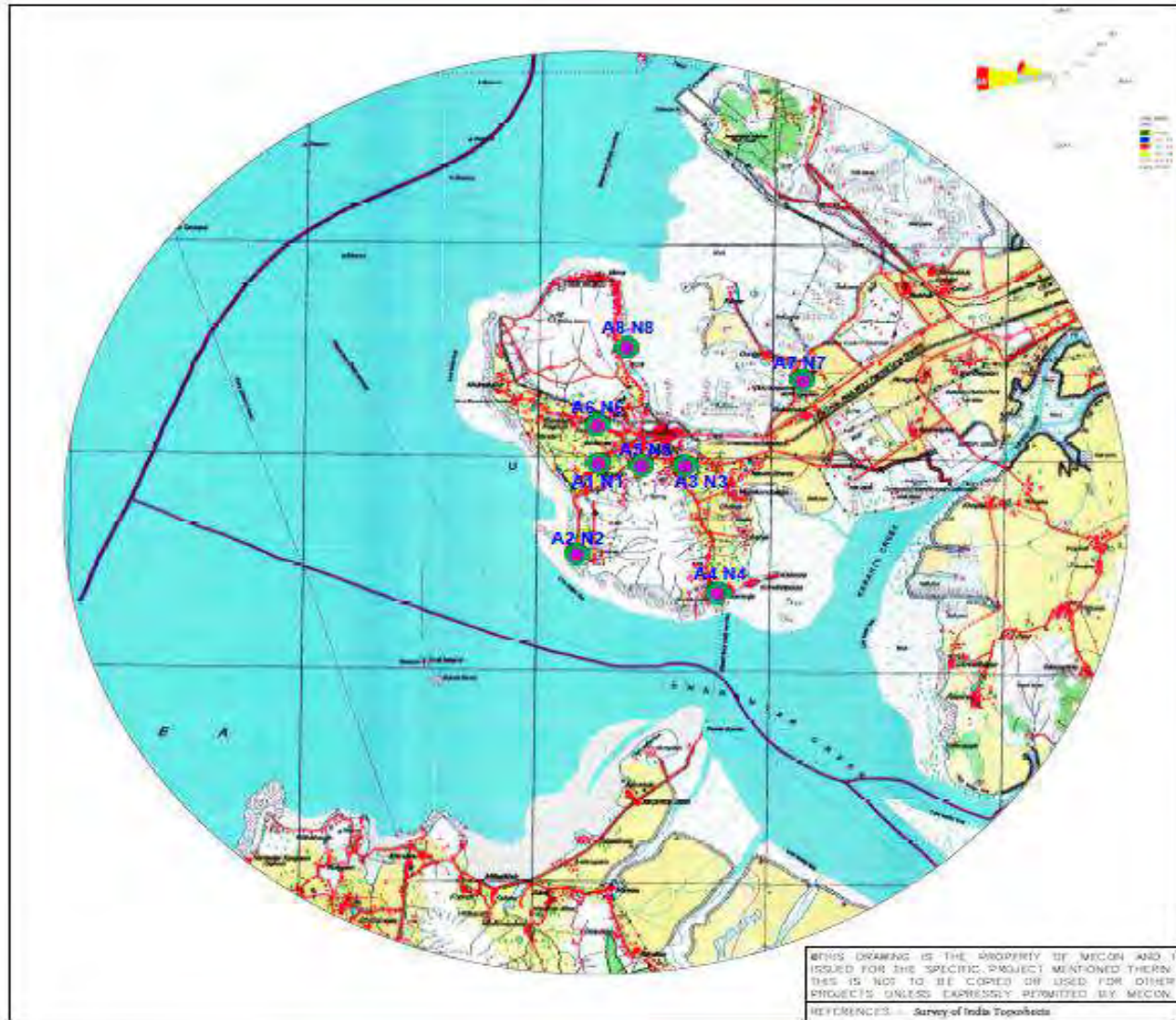


Fig. 3.3: Locations of monitoring stations for Ambient air

Monitoring schedule

As mentioned earlier, the EIA report has been prepared on the basis of Ambient Air Quality data generated in the study area for one full season covering twelve weeks of summer season, 2017. Samples of 24 hourly duration were taken on each monitoring day on two days a week for twelve weeks (i.e. 24 samples were collected at each location) for PM₁₀, PM_{2.5}, SO₂ and NO_x. In case of CO one hourly samples were taken on each monitoring day. For NH₃, H₂S, Ni, Pb, As and Benzo-a-Pyrene 24 hourly samples were collected on selected monitoring days. In case of Methane (CH₄), Non-Methane Hydrocarbons, Benzene (C₆H₆) and Volatile Organic Carbons (VOCs), 4-hourly samples were collected on selected monitoring days. Ambient air also monitored at 8 locations during September-November, 2018 to collect fresh baseline data.

Methods of Sampling and Analysis

The methods of sample collection, equipment used and analysis procedures as followed are given in **Table 3.4** and National Ambient Air Quality Standards, 2009 are given in **Table 3.5**.

Table 3.4: Methodology of Sampling & Analysis and Equipment used

Sl. No.	Parameters	Method followed
1.	PM10	Gravimetric. IS:5182 (Part 23)
2.	PM2.5	Gravimetry
3.	NOx	Jacobs and Hochheiser modified (Na-arsenite) Method. IS:5182 (Part VI)
4.	SO2	Improved West & Gaecke method: IS:5182 (Part II)
5.	CO	NDIR Method
6.	NH3	Indophenol blue method
7.	Pb	AAS method after sampling on EPM 2000 filter paper
8.	As	AAS method after sampling on EPM 2000 filter paper
9.	Ni	AAS method after sampling on EPM 2000 filter paper
10.	C6H6	Adsorption and Desorption followed by GC analysis
11.	Benzo(a)Pyrene	Solvent extraction followed by HPLC analysis
12.	H2S	Colorimetric Method: IS:5182 (Part VII)
13	CH4	IS:5182 (Part XVII)
14	Non-Methane Hydrocarbons	
15	VOCs	NIOSH 1501 - 2003

Table 3.5: National Ambient Air Quality Standards, 2009

Sl. No.	Parameter	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Area (Notified by Central Government)
1	Sulphur Dioxide (SO ₂); (µg/m ³)	Annual*	50	20
		24 Hours**	80	80
2	Nitrogen Dioxide (NO _x); (µg/m ³)	Annual*	40	30
		24 Hours**	80	80
3	Particulate Matter, PM ₁₀ ; (µg/m ³)	Annual*	60	60
		24 Hours**	100	100
4	Particulate Matter, PM _{2.5} ; (µg/m ³)	Annual*	40	40
		24 Hours**	60	60
5	Carbon Monoxide (CO); (mg/m ³)	8 Hours **	02	02
		1 Hour **	04	04
6	Ozone (O ₃); (µg/m ³)	8 Hours **	100	100

		1 Hour **	180	180
7	Ammonia (NH ₃); (µg/m ³)	Annual*	100	100
		24 Hours**	400	400
8	Lead (Pb); (µg/m ³)	Annual*	0.50	0.50
		24 Hours**	1.0	1.0
9	Arsenic (As); (ng/m ³)	Annual*	06	0.6
10	Nickel (Ni); (ng/m ³)	Annual*	20	20
11	Benzene (C ₆ H ₆); (µg/m ³)	Annual*	05	05
12	Benzo(a)Pyrene (BaP); (ng/m ³)	Annual*	01	01

**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 compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days.*

Results and Discussions

The summarized results of ambient air quality monitoring are given in **Table 3.6**.

Table 3.6: Summarised Ambient Air Quality Monitoring Results

Parameter	Monitoring eqpt. Used	Equipment sensitivity	Statistical data	Nagaon	Pirwadi	Daurnagar	Karanja	Mora	Kegaon	Funde	ONGC plant gate
PM ₁₀ (µg/m ³)	Respirable Dust Sampler (RDS)	Detection Limit: 5(µg/m ³)	Max	62.2	60.6	61.4	63.1	62.7	61.1	61.9	63.6
			Min	46.2	42.8	48.2	48.2	46.7	43.3	48.7	48.7
			C98	61.8	60.5	60.9	62.7	62.3	61.0	61.4	63.2
PM _{2.5} (µg/m ³)	PM _{2.5} Dust	Detection Limit: 5(µg/m ³)	Max	32.2	32.2	30.6	34.6	32.5	32.5	30.9	34.9
			Min	20.8	18.4	22.6	24.4	21.1	18.7	22.9	24.7
			C98	31.5	31.3	30.4	34.1	31.8	31.6	30.7	34.4
SO ₂ (µg/m ³)	RDS & Spectrophotometer	Detection Limit: 4(µg/m ³)	Max	7.6	6.9	7.2	7.4	9.1	7.4	8.2	9.4
			Min	5.6	5.2	5.6	6.2	7.1	5.7	6.6	8.2
			C98	7.3	6.9	7.1	7.4	8.8	7.4	8.1	9.4
NO _x (µg/m ³)	RDS & Spectrophotometer	Detection Limit: 10(µg/m ³)	Max	28.4	28.5	28.6	32.4	29.9	29.5	29.1	34.4
			Min	13.2	14.2	14.4	21.2	14.7	15.2	14.9	23.2
			C98	27.3	27.7	28.2	31.5	28.8	28.7	28.7	33.5
CO (µg/m ³)	NDIR Method	Detection Limit: 0.057mg/m ³	Max	3545	2094	2890	2607	2876	3121	3100	2798
			Min	1104	833	1165	735	1002	985	816	995
			C98	3475	2072	2861	2449	2676	3008	2810	2795
NH ₃ (µg/m ³)	Indophenol blue method	Detection Limit: 4.2(µg/m ³)	Max	25.5	27.0	26.8	22.8	30.3	26.3	23.0	28.3
			Min	13.8	15.6	16.3	13.9	22.0	10.3	15.5	17.1
			C98	20.2	25.4	24.8	21.7	27.5	24.0	22.6	28.1
			Min	2.9	3.1	2.1	7.6	1.6	3.9	<0.69	3.4
Benzene (µg/m ³)	Adsorption and Desorption followed by GC analysis	Detection Limit: 2.01(µg/m ³)	Max	2.73	2.64	3.91	4.90	3.33	4.21	3.58	4.97
			Min	<2.01	2.27	<2.01	<2.01	<2.01	<2.01	<2.01	<2.01
			C98	2.65	2.48	3.25	3.95	3.30	3.13	3.45	3.37
BaP (ng/m ³)	Solvent extraction followed by HPLC analysis	Detection Limit: 0.22(ng/m ³)	Max	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22
			Min	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22
			C98	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22
Methane (µg/m ³)		Detection Limit: 327 (µg/m ³)	Max	1275.95	1502.24	1588.57	889.44	1198.13	1316.50	1354.43	1097.41
			Min	742.94	786.76	807.04	581.41	<327	994.08	712.86	854.78
			C98	1202.71	1100.68	1585.95	808.34	1150	1141.88	967.27	1008.47

Non-Methane HCs ($\mu\text{g}/\text{m}^3$)	Detection Limit: $327(\mu\text{g}/\text{m}^3)$	Max	6264.21	5834.10	4613.33	6729.89	3651.16	4433.32	4601.65	6578.56
		Min	1907.35	1686.46	1271.21	1204.31	597.38	994.08	1584.50	2317.82
		C98	4765.19	5588.78	2433.57	3344.77	3529.56	4396.15	3323.0	4886.26
Volatile Organic Carbon (VOCs) ($\mu\text{g}/\text{m}^3$)	Detection Limit: $2.08(\mu\text{g}/\text{m}^3)$	Max	19.31	<2.08	<2.08	<2.08	<2.08	112.44	7.03	<2.08
		Min	<2.08	<2.08	<2.08	<2.08	<2.08	2.08	2.08	<2.08
		C98	<2.08	<2.08	<2.08	<2.08	<2.08	77.95	3.11	<2.08

The results when compared with National Ambient Air Quality Standards (NAAQS), 2009 of Central Pollution Control Board (CPCB). Maximum PM₁₀ was observed as 63.6 µg/m³ at ONGC plant gate and minimum was observed as 42.8 µg/m³ at Pirwadi. 98th Percentile values of PM₁₀ was observed as 60.5-63.2. Maximum PM_{2.5} was observed as 30.6 µg/m³ at Daurnagar and minimum was observed as 18.4 µg/m³ at Pirwadi. 98th Percentile values of PM_{2.5} was observed as 30.7-34.4. Maximum SO₂ was observed as 9.4 µg/m³ at ONGC plant gate and minimum was observed as 5.2 µg/m³ at Pirwadi. 98th Percentile values of SO₂ was observed as 6.9-9.4. Maximum NO_x was observed as 34.4 µg/m³ at ONGC plant gate and minimum was observed as 28.4 µg/m³ at Nagaon. 98th Percentile values of NO_x was observed as 27.3-33.5. 98th Percentile values of Benzene was observed as 2.48-3.95. The 98 percentile values of all parameters with reference to were found to be within limits of National Ambient Air Quality Standards (NAAQS), 2009.

ONGC has also arranged to monitor the air quality within its premises at the following locations through an accredited laboratory:

1. Near PPCL Building at APU Power Sub-station
2. Near NGL gate
3. Near Slug Catcher
4. Near Dronagiri Bhavan

24 hourly samples were collected for Lead, Ammonia, Benzene, Benzo-a-Pyrene, Arsenic and Nickel. 8 hourly samples were collected for Ozone. Samples are collected twice a week, for 4 weeks per month. The sampling and analysis is carried out by an accredited laboratory. The results are given in **Table 3.7**.

Table 3.7: Summarised Work Zone Air Quality Monitoring Results

Parameter	Equipment Sensitivity	Statistical Data	Near PPCL Building	Near NGL Gate	Near Slug Catcher	Near Dronagiri Bhavan
O ₃ (mg/m ³)	Detection Limit: 0.057mg/m ³	Max	-	3.5	3.5	3.5
		Min	-	1.5	1.8	1.5
		C98	-	3.3	3.3	3.5
NH ₃ (µg/m ³)	Detection Limit: 4.2µg/m ³	Max	-	12.7	13.0	12.8
		Min	-	8.1	8.2	8.1
		C98	-	12.6	12.7	12.5
Pb (µg/m ³)	Detection Limit: 0.7µg/m ³	Max	0.44	0.60	0.43	0.41
		Min	0.23	0.24	0.15	0.15
		C98	0.38	0.54	0.37	0.37
As (ng/m ³)	Detection Limit: 1.81ng/m ³	Max	<1.81	<1.81	<1.81	<1.81
		Min	<1.81	<1.81	<1.81	<1.81
		C98	<1.81	<1.81	<1.81	<1.81
Ni (ng/m ³)	Detection Limit: 0.63ng/m ³	Max	2.0	<0.63	2.1	2.2
		Min	<0.63	<0.63	<0.63	<0.63
		C98	1.9	<0.63	1.8	2.0

Benzene ($\mu\text{g}/\text{m}^3$)	Detection Limit: $2.01\mu\text{g}/\text{m}^3$	Max	4.4	4.3	4.2	4.2
		Min	2.4	1.5	1.7	1.5
		C98	4.4	4.2	4.2	4.1
BaP (ng/m^3)	Detection Limit: $0.22\text{ng}/\text{m}^3$	Max	<0.22	<0.22	<0.22	<0.22
		Min	<0.22	<0.22	<0.22	<0.22
		C98	<0.22	<0.22	<0.22	<0.22

The Maximum Permissible Limits of the above substances as specified in The Second Schedule of the Indian Factories Act is as follows:

Substance	Time Weighted average concentration (8 hrs)
Benzene	20
Ammonia	18
Arsenic & compounds (as As)	0.2
Nickel carbonyl (as Ni)	0.35
Ozone	0.2
Lead, inorganic, fumes and dusts (as Pb)	0.15
All values in mg/m^3	

Thus the work zone air quality prevailing within the plant is well within the norms at least in terms of Benzene, Ammonia, Arsenic, Lead, Nickel and Benzo-a-Pyrene

3.7 NOISE ENVIRONMENT

The word noise arose from the Latin word 'nauseas', it is a loud outcry or commotion that is unpleasant, unexpected, or undesired with various frequencies over the audible range due to the regular activities of the Mankind primarily Noise pollution (or environmental noise) is displeasing human, animal or machine-created sound that disrupts the activity or balance of humans or animals life. The source of most outdoor noise worldwide is mainly evolved from Industries, constructions and transportation systems, including motor vehicle noise, aircraft noise and rail noise, poor urban planning may give rise to noise pollution.

Industrial Noise resulting to noise pollution has many reasons such as industries being close to human habitats which prevent the noise from decaying before it reaches human ear. A determination is made of the micro scale impact by predicting anticipated noise levels for each alternative during both construction and operational phases. Predicted noise levels are compared with applicable standards or criteria in order to assess the impact.

The physical description of sound concerns its loudness as a function of frequency. Noise in general sound which comprises of many frequency components with different variations in loudness over the audible frequency range.

Various noise scales have been introduced to describe, a single number, the response of an average human to a complex sound made up of various frequencies at different loud levels,

the response of the human ear to sound is dependent on the frequency of the sound and this has led to the concept of weighting scales. In the "A-weighting" scale, the sound pressure levels for the lower frequencies and higher frequencies are reduced by certain amounts before they are being combined together to give one single sound pressure level value. This value is designated as dB(A). The dB(A) is often used as it reflects more accurately the frequency response of the human ear. A perceived loud noise has a high dB or dB(A) value and a soft noise has a low one. The human ear has peak response around 2,500 to 3,000 Hz and has a relatively low response at low frequencies.

3.7.1 METHODOLOGY OF NOISE MEASUREMENT

Noise level monitoring was carried out continuously for 24 hours with one hour interval starting at 06.00 hrs to 06.00 hrs next day. The noise levels were monitored on working days only and Saturdays, Sundays and public holidays were not monitored. During each hour, Leq were directly computed by the instrument based on the sound pressure levels. Lday (Ld), Lnight (Ln) and Ldn values were computed using corresponding hourly Leq of day and night respectively. Monitoring was carried out at 'A' response and fast mode.

Parameters measured during monitoring

For Noise levels measured over a given period of time interval, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time as certain noise levels are exceeding the time interval. The notations for the statistical quantities of noise level are given below:

- L_{10} is the noise level exceeded 10% of the time.
- L_{50} is the noise level exceeded 50% of the time and
- L_{90} is the noise level exceeded 90% of the time

Equivalent Sound Pressure Level (L_{eq}):

The L_{eq} is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because sound from noise source often fluctuates widely during a given period of time.

This is calculated from the following equation

$$L_{eq} = L_{50} + (L_{10} - L_{90})^2 / 60$$

L_{day} is defined as the equivalent noise level measured over a period of time during day (6 am to 10 pm). L_{night} is defined as the equivalent noise level measured over a period of time during night (10 pm. 6 am). A noise rating developed by Environment Protection Agency, USEPA for specification of community noise from all the sources is Day-Night Sound Level, (L_{dn}). Hourly noise recorded data and L_{day} values (16 hours) L_{night} (8 hours) and L_{dn} (24 hours) are computed and tabulated.

Day-Night Sound levels (L_{dn}):

The noise rating developed for community noise from all sources is the Day-Night Sound Level, (L_{dn}). It is similar to a 24 hr equivalent sound level except that during night time period (10 pm to 6 am) A 10 dB (A) weighting penalty is added to the instantaneous sound level before computing the 24 hr average.

This time penalty is added to account for the fact that noise during night when people usually sleep is judged as more annoying than the same noise during the daytime.

The L_{dn} for a given location in a community may be calculated from the hourly

L_{eq}^S , by the following equation.

$$L_{dn} = 10 \log \{ 1/24 [15(10^{L_d/10}) + 9(10^{9L_n + 10}) / 10] \}$$

Where L_d is the equivalent sound level during the day time (6 am to 10 pm) and L_n is the equivalent sound level during the night time (10 pm to 6 am).

The statistical analysis is done for measured noise levels at 8 locations.

3.7.2 Data Analysis

In order to have an idea about the existing ambient noise level of the study area, noise monitoring has been carried out during summer season, 2017 at the eight locations where ambient air quality had been monitored (refer Table 3.10).

Noise Monitoring Frequency

Monitoring was carried out once during Summer Season, 2017. At each ambient noise monitoring station, L_{eq} Noise level has been recorded at hourly intervals for 24 hours continuously by operating the noise-recording instrument for fifteen (15) minutes during each hour. In case of Work Zone noise, the monitoring was carried out for eight hours during the General Shift.

Results and Discussions

The summarized results of ambient noise monitoring are given in Table 3.9. The results have been compared with the standard specified in Schedule III, Rule 3 of Environmental Protection Rules given in Table 3.10.

Table 3.9: Summarised Results of Ambient Noise Monitoring

Stn. No.	Location	Monitoring Dates	Results								
			Day (0600-2200 hr.)			Night (2200-0600 hr.)					
			Max.	Min.	Avg.*	Max.	Min.	Avg.*			

N1	Village Nagaon	27 - 28 April,'17	54.6	39.2	48.1	41.5	36.2	38.7
N2	Village Pirwadi	26 - 27 April,'17	57.4	44.8	53.0	45.6	40.9	43.6
N3	Village Daurnagar	04 - 05 May,'17	56.3	43.7	51.9	44.2	37.4	40.9
N4	Village Karanja	03 - 04 May,'17	52.8	40.7	46.4	44.8	38.2	41.2
N5	ONGC Plant Main Gate	25 - 26 April,'17	63.6	47.4	58.4	52.4	46.1	49.5
N6	Village Kegaon	28 - 29 April,'17	53.0	40.9	47.4	41.9	36.5	38.7
N7	Village Funde	02 - 03 May,'17	55.6	40.7	52.7	44.1	36.9	40.4
N8	Village Mora	05 - 06 May,'17	49.7	39.2	45.7	42.9	37.4	39.6
* <i>Logarithmic Averages. All Values in dB (A).</i>								

Table 3.10: Ambient Air Quality norms in respect of Noise (As Per Schedule III, Rule 3 of Environment Protection Rules)

Type of Area	Day (0600 – 2200 hrs.)	Night (2200 – 0600 hrs.)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40
<i>All Values in dB (A)</i>		

The results indicate that day time noise levels at all the residential areas, day-time as well night time noise levels were within the norms for “Residential Areas”. At the Plant Main Gate, the noise levels were within the norms for “Industrial Areas”.

Occupational Health Centre of Uran Plant is monitoring noise levels at various locations in the plant regularly. The results of work zone noise monitoring in the plant area during April, 2017 are given in Table 3.11.

Table 3.11: Results of Work Zone Noise Monitoring by ONGC

Sl. No.	Source	Noise near Source	Cabin Noise	Noise in Working Zone	Exposure to Working Noise (Time)
A. In Co-Generation Plant					
1	HRSG – I Boiler	92 - 93	72 - 74	90 - 93	5 minutes / 3 hours
2	HRSG – II Boiler	90 - 92	72 - 74	89 - 92	10 minutes / 3 hours
3	HRSG – II Feed Pump	90 - 91	72 - 74	88 - 90	5 minutes / 3 hours
4	HRSG – III Boiler	88 - 91	72 - 74	87 - 90	10 minutes / 3 hours
5	GT-I	98 - 100	72 - 74	95 - 99	5 minutes / 3 hours
6	GT-II	92 - 94	72 - 74	90 - 93	5 minutes / 3 hours
7	GT-III	92 - 94	72 - 74	90 - 93	5 minutes / 3 hours
8	FD Fan 210/C1	93 - 94	72 - 74	92 - 94	5 minutes / 3 hours
9	Boiler feed water pump	91 - 93	72 - 74	90 - 93	5 minutes / 3 hours
B. IHI Compressor Area					
10	Compressor 201A (IHI)	87 – 88	66 - 67	85 – 87	5 minutes / 4 hours
11	Electrical Compressor (RGT)	88 – 89	66 - 67	86 – 88	5 minutes / 4 hours

12	Compressor K102B	82 – 84	66 - 67	81 – 83	5 minutes / 4 hours
13	Compressor K201B	87 - 88	66 - 67	85 - 87	5 minutes / 4 hours
C. APU - Cooling Water, Service Water & Fire Water Pump House					
14	Fire water diesel pump	94 - 95	60 - 62	93 - 95	5 minutes / 4 hours
15	Fire water pump P-4703A	83 - 84	60 - 62	80 - 83	5 minutes / 4 hours
16	Service Water pump P2120B	84 – 85	60 - 62	82 – 84	5 minutes / 4 hours
17	Cooling Tower Pump P2103A	95 – 96	60 - 62	94 – 96	5 minutes / 4 hours
18	Cooling Tower Pump P2103C	98 – 100	60 - 62	98 – 100	5 minutes / 4 hours
19	Cooling Tower Pump P2103D	96 - 98	60 - 62	96 - 98	5 minutes / 4 hours
D. APU – Air Compressor House Area					
20	Compressor K-2201B	98 – 100	62 - 64	96 – 98	5 minutes / 4 hours
21	Compressor IG K-1830	97 - 98	62 - 64	96 - 98	5 minutes / 4 hours
E. CFU III Area					
22	Compressor K-2601B	76 - 77	64 - 66	75 - 77	5 minutes / 4 hours
23	Steam Condensate P-2603B	86 - 87	64 - 66	85 - 87	5 minutes / 4 hours
24	LPG Reflux Pump P-2602B	90 - 92	64 - 66	88 - 91	5 minutes / 4 hours
25	Stripper bottom pump P-2601A	86 - 88	64 - 66	86 - 88	5 minutes / 4 hours
26	LPG Column Reflux Pump	94 - 96	64 - 66	94 - 96	5 minutes / 4 hours
F. Gas Sweetening Unit III Area					
27	Booster Pump P-1402A	87 – 88	66 – 67	86 – 88	5 minutes / 4 hours
28	Reflux Pump P-1403B	85 – 86	66 – 67	84 – 86	5 minutes / 4 hours
29	Condensate Pump P-1409B	85 - 86	66 - 67	84 - 86	5 minutes / 4 hours
G. LPG – III Plant Area					
30	Propane gas compressor 402C	89 – 91	79 - 80	88 - 91	5 minutes / shift
31	Lean gas compressor	102 – 104	79 - 80	100 – 102	5 minutes / shift
32	Expander Compressor EK-401B	94 – 95	79 - 80	92 – 94	5 minutes / shift
33	LEF Reflux Pump	85 – 86	79 - 80	84 – 86	5 minutes / shift
34	LPG Reflux Pump	88 – 90	79 - 80	87 – 90	5 minutes / shift
35	LP Separator Pump	92 – 93	79 - 80	90 – 93	5 minutes / shift
36	Steam Condensate Pump	88 - 90	79 - 80	87 - 90	5 minutes / shift
H. C2C3 Cooling Water, Fire water and Compressor House					
37	Compressor K-1801A	98 - 100	62 - 64	98 – 100	5 minutes / 3 hours
38	Cooling water pump 1804B	86 - 87	62 - 64	85 – 87	5 minutes / 3 hours
39	Cooling water pump 1804C	85 – 86	62 - 64	84 – 86	5 minutes / 3 hours
40	Service water pump 1802A	97 – 98	62 - 64	96 - 98	5 minutes / 3 hours
41	Cooling water make-up pump	86 - 88	62 - 64	85 - 87	5 minutes / 3 hours
I. C2C3 EPRU Area					
42	Expander Compressor EK-1501A	92 - 93	74 - 75	90 - 92	5 minutes / 4 hours
43	Expander Compressor EK-1501B	88 – 90	74 - 75	87 – 89	10 minutes / 4 hours
44	Expander Compressor EK-1502A	88 – 89	74 - 75	87 – 89	10 minutes / 4 hours
45	Expander Compressor EK-1502B	86 – 88	74 - 75	84 – 87	10 minutes / 4 hours
46	Propane Compressor K1504	92 – 94	74 - 75	90 – 94	5 minutes / 4 hours
47	Lean Gas Compressor K1503A	90 – 92	74 - 75	90 – 92	5 minutes / 4 hours
48	Lean Gas Compressor K1503B	90 – 92	74 - 75	89 - 92	5 minutes / 4 hours
49	C2C3 Product Storage pump	88 - 90	74 - 75	87 - 90	5 minutes / 4 hours
50	Reflux pump P-1501A	87 - 88	74 - 75	86 - 88	5 minutes / 4 hours
51	C2C3 Despatch Pump	88 - 90	74 - 75	87 - 90	5 minutes / 4 hours
J. C2C3 Gas Sweetening Area					

52	Pump P-1202A	86 - 87	62 - 63	85 - 87	2 minutes / 4 hours
53	Pump P-1203B	83 - 83	62 - 63	81 - 83	2 minutes / 4 hours
54	Pump P-1204B	95 - 97	62 - 63	93 - 96	10 minutes / 4 hours
55	Pump P-1302A	83 - 85	62 - 63	83 - 85	2 minutes / 4 hours
56	Pump P-1303A	84 - 85	62 - 63	83 - 85	2 minutes / 4 hours
57	Pump P-1304A	96 - 98	62 - 63	94 - 97	10 minutes / 4 hours
K. LPG I Air Compressor House Area					
58	Compressor K-301A	90 - 92	64 - 66	89 - 91	5 minutes / 3 hours
59	Compressor K-301B	90 - 91	64 - 66	88 - 90	5 minutes / 3 hours
60	Booster Compressor K-302	84 - 86	64 - 66	84 - 86	5 minutes / 3 hours
61	Compressor K-701A	88 - 89	64 - 66	86 - 88	5 minutes / 3 hours
L. LPG I Plant Area					
62	Furnace 101	72 - 74	70 - 72	72 - 74	5 minutes / 4 hours
63	LEF Reflux Pump 101A	85 - 86	70 - 72	84 - 86	5 minutes / 4 hours
64	LPG Reflux Pump 102B	92 - 93	70 - 72	90 - 93	5 minutes / 4 hours
M. LPG I Cooling Water, Service Water & Fire Water Pump House					
65	Cooling water pump 303B	96 - 98	62 - 64	95 - 97	5 minutes / 3 hours
66	Cooling water pump 303C	95 - 97	62 - 64	93 - 96	5 minutes / 3 hours
67	Service water pump P322B	94 - 95	62 - 64	93 - 95	5 minutes / 3 hours
68	Drinking water pump P316B	86 - 87	62 - 64	84 - 86	5 minutes / 3 hours
<i>All Values in dB (A).</i>					

The Occupational Safety and Health Administration (OSHA) of United States Department of Labour has formulated the following Permissible Noise Exposure Limits:

Sound Level in dB(A)	Duration Per Day (hours)
90	8
92	6
95	4
97	3
100	2
102	1.5
105	1
110	0.5
115	<0.25

From the results of work zone noise monitoring as given in **Table 3.11**, it is obvious that personnel deployed in certain areas of the plant such as near compressors, pumps and turbines may be exposed to very high noise levels, which may lead to temporary or in case of prolonged exposure, even permanent health impairment.

3.8 TRAFFIC SURVEY

Traffic density recording has been carried at 2 locations, which are as follows:

Table 3.12: Locations of Traffic Survey

Stn. No.	Traffic Density Location	Date of recording
TD 1	In front of ONGC Uran Plant Main Gate	26/4/2017
TD 2	In front ONGC's Uran Township	2/5/2017

The numbers and types of vehicles passing through at each of the stations were recorded at hourly intervals for 24 hours continuously.

Results

The observations of traffic density analysis station are given in **Tables 3.13** and **3.14**

Table 3.13: Traffic In front of ONGC Uran Plant Main Gate

Time	Towards Pirwadi			From Pirwadi			TOTAL	Traffic In Terms Of PCUs *
	2 Wheelers	LMVs	HMVs	2 Wheelers	LMVs	HMVs		
0600 – 0700 hrs.	152	11	3	210	38	3	417	248
0700 – 0800 hrs.	212	30	9	287	19	11	568	358.5
0800 – 0900 hrs.	282	93	17	233	22	12	659	459.5
0900 – 1000 hrs.	408	187	32	210	63	8	908	679
1000 – 1100 hrs.	369	102	22	302	37	27	859	621.5
1100 – 1200 hrs.	315	68	21	220	22	7	653	441.5
1200 – 1300 hrs.	143	42	7	212	68	17	489	359.5
1300 – 1400 hrs.	262	135	16	252	27	21	713	530
1400 – 1500 hrs.	256	105	6	285	53	15	720	491.5
1500 – 1600 hrs.	168	76	13	246	84	47	634	547
1600 – 1700 hrs.	395	27	31	377	107	21	958	676
1700 – 1800 hrs.	141	37	12	352	153	27	722	553.5
1800 – 1900 hrs.	187	20	3	267	142	61	680	581
1900 – 2000 hrs.	107	36	0	252	89	12	496	340.5
2000 – 2100 hrs.	192	47	2	183	27	0	451	267.5
2100 – 2200 hrs.	87	22	0	72	7	0	188	108.5
2200 – 2300 hrs.	45	7	0	28	4	0	84	47.5
2300 – 0000 hrs.	11	0	0	14	3	0	28	15.5
0000 – 0100 hrs.	0	2	0	4	12	0	18	16
0100 – 0200 hrs.	0	0	0	0	2	0	2	2
0200 – 0300 hrs.	0	0	0	0	0	0	0	0
0300 – 0400 hrs.	0	0	0	0	0	0	0	0
0400 – 0500 hrs.	37	4	0	7	0	0	48	26
0500 – 0600 hrs.	85	17	0	137	17	0	256	145
TOTAL	3854	1068	194	4150	996	289	10551	7515

*PCU = Passenger Car Unit; 1 truck is equivalent to 3 PCUs, one two-wheeler is equivalent to 0.5 PCU & one LMV is equivalent to 1 PCU

Table 3.14: Traffic In front of ONGC's Uran Township

Time	Towards Pirwadi			From Pirwadi			TOTAL	Traffic In Terms Of PCUs *
	2 Wheelers	LMVs	HMVs	2 Wheelers	LMVs	HMVs		
0600 – 0700 hrs.	185	202	65	264	131	87	934	1013.5
0700 – 0800 hrs.	375	190	150	462	355	56	1588	1581.5
0800 – 0900 hrs.	492	188	138	325	150	142	1435	1586.5
0900 – 1000 hrs.	1033	218	165	366	190	118	1707	1765
1000 – 1100 hrs.	960	273	220	360	300	148	1768	2090.5
1100 – 1200 hrs.	630	218	107	220	210	117	1177	1362.5
1200 – 1300 hrs.	776	253	185	410	181	85	1452	1618
1300 – 1400 hrs.	398	136	95	218	197	22	835	876.5
1400 – 1500 hrs.	573	228	103	285	123	85	1066	1178.5
1500 – 1600 hrs.	735	290	142	372	175	42	1324	1354.5
1600 – 1700 hrs.	460	125	80	347	245	132	1184	1307
1700 – 1800 hrs.	707	242	97	462	137	107	1413	1406
1800 – 1900 hrs.	812	247	143	481	172	140	1605	1719.5
1900 – 2000 hrs.	851	318	45	405	178	110	1544	1407.5
2000 – 2100 hrs.	594	205	32	542	214	112	1462	1300.5
2100 – 2200 hrs.	573	222	16	237	125	16	951	729
2200 – 2300 hrs.	249	55	2	182	26	0	457	274
2300 – 0000 hrs.	85	30	0	30	11	0	126	83.5
0000 – 0100 hrs.	22	7	0	0	27	0	49	41.5
0100 – 0200 hrs.	28	3	0	0	7	0	35	22.5
0200 – 0300 hrs.	17	17	0	0	0	0	17	17
0300 – 0400 hrs.	7	7	0	2	2	0	11	10
0400 – 0500 hrs.	13	132	0	0	16	3	32	38
0500 – 0600 hrs.	62	32	13	58	47	11	178	188.5
TOTAL	6053	3719	1798	6028	3219	1533	22350	22971.5

*PCU = Passenger Car Unit; 1 truck is equivalent to 3 PCUs, one two-wheeler is equivalent to 0.5 PCU & one LMV is equivalent to 1 PCU

At both locations the traffic was dominated by 2-wheelers. In front of the Plant Main Gate, there was virtually no movement of heavy vehicles (trucks & buses) during 9 p.m. to 6 a.m. In front of ONGC's Uran Township, the traffic was much heavier because of movement of people and goods to & from Uran and Karanja.

As per IRC:64 "Guidelines for Capacity of Roads in Rural Areas", the recommended design service volume for two lane roads on plain terrain is 15000 Passenger Car Units (PCUs) per day and the reduction factor for shoulder width of 1.2 m is 0.92. Accordingly, the recommended design service volume comes down to 13800 PCUs/day. Accordingly, the road in front of the Uran Plant's gate is adequate. However the approach road needs widening to meet the present traffic volume.

3.9 WATER ENVIRONMENT

Water of high quality is essential to human life, and water of acceptable quality is essential for agricultural, industrial, domestic and commercial uses; in addition, most recreation is water based; therefore, major activities having potential effects on surface water are certain to be of appreciable concern to the consumers. The present study is carried out to understand water quality of the area, so as to understand the impacts, prediction and evaluation.

Water quality studies have been carried out in the study area to understand the availability of water resources, possibility of water contamination and existing water quality.

3.9.1 Water Quality

Selected water quality parameters of surface and ground water resources within 10 km radius of the study area has been studied for assessing the water environment and evaluate anticipated impact of the project. Understanding the water quality is essential in preparation of Environmental Impact Assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities.

The information required has been collected through primary surveys and secondary sources.

3.9.2 Selection of water quality locations

Reconnaissance survey was conducted and monitoring locations were finalized based on the location of residential areas representing different activities/likely impact areas, areas which can represent baseline conditions and drainage pattern.

3.9.3 Sample collection and analysis

The water resource in the study area may be classified into two major categories. viz., surface and ground water sources.

Water samples were collected at 4 locations each for ground and surface water sources. All the samples were analyzed for parameters such as hardness, alkalinity, salts, conductivity, inorganic substance, heavy metals, coliforms etc. Parameters like pH, conductivity, temperature and DO were analyzed at the time during collection. These parameters were analyzed as per the procedures specified in 'Standard Methods for Examination of Water

and Wastewater' published by American Public Health Association (APHA). Ground water samples results were compared with IS: 10500 specification and surface water samples results were compared with Water Quality Criteria, published by CPCB.

3.9.4 Method of Water Sampling

The following procedures were used while sampling

- Washing the bottles/cans with distilled water prior to the sampling
- Before collection of water the bottles/cans are again washed 2-3 times with the same water
- For surface water, Bottles were lowered to a minimum depth of 30 cm below water surface
- At each point Different sets of water samples were collected so as cover all the parameters
- Meticulous attention is taken in proper numbering at the site
- Sterilized bottles were used for the samples that are to be analyzed for bacteria
- Civil supply water pipeline taps are sterilized before collection for bacteriological analysis
- Parameters like pH, conductivity and temperature were analyzed in the field conditions and the results were reconfirmed after getting to the laboratory. DO is fixed and titrated in the field itself.
- Appropriate preservatives are added, depending upon the elements to be analyzed and marked accordingly (IS: 3025 (part I) 1987)
- All the water samples collected in the ice box, were immediately transported to the laboratory and free zed at 5°C analysis
- Field observations were noted in the field notebook
- As far as possible photographs were taken in almost all sampling points

All the parameters have been analysed as per APHA, 20th edition & IS: 3025. Summary of the same is given in Table 3.15.

Table 3.15: Parameters & Methodologies Adopted in Assessing Quality of Water

Quality	Parameter	Method
	pH	pH meter
	Colour	Visual Method
	Odour	Manual Method
	Taste	Taste Threshold Test
	Temperature	Thermometer
	Turbidity	Nephelometric method
	Salinity	Electrical Conductivity Method
	Total Suspended Solids	Filtration & Evaporation method
	Total Dissolved Solids	Evaporation method
	Total Alkalinity	Titration Method

Quality	Parameter	Method
Physico-chemical	Total Hardness	EDTA Titrimetric method
	Ca Hardness	EDTA Titrimetric method
	Mg Hardness	EDTA Titrimetric method
	Chlorides	Argentometric method
	Sulphates	Nephelometric method
	Sodium	Flame photometric method
	Potassium	Flame photometric method
	Nitrates	U.V.Spectrophotometric method
	Total Phosphates	U.V.Spectrophotometric method
	Total Nitrogen	Kjeldhal Method
	Total Phosphorus	Ascorbic acid method
	Pesticides	GC-MS
	Anionic Detergents	Spectroscopic Method
	SW1 (Phytoplankton)	Plankton net followed by
SW1 (Zooplankton)	Microscopic Observation	
Biological	Dissolved Oxygen, mg/l	Azide modification
	COD, mg/l	Open reflux method
	BOD ₅ , mg/l	Dilution & DO by Winkler's method
Bacteriological	Total Coliform, MPN/100ml	Multiple tube MPN test

3.9.5 Water Quality

Sources of water in the study area are surface water in sea / creeks and ground water. Water samples have been collected once during summer season, 2017 from ten (10) locations, which are listed in **Table 3.16**. The locations of the surface water and ground water sampling points are marked in Fig. 3.4.



Fig. 3.4: Locations of the surface water and ground water sampling points
Table 3.16: Water Sampling Locations, Summer Season, 2017

Sl. No.	Location Name	Latitude	Longitude	Stn. No.	Type	Distance & Direction from Plant
1	Tube-well, Nagaon	18°52'26.2"N	72°55'40.2"E	GW1	Ground Water	0.4 km NW
2	Open Well, Kegaon	18°52'58.4"N	72°55'15.4"E	GW2	Ground Water	1.6 km NW
3	Bore-well, Daarnagar	18°52'20.1"N	72°56'18.2"E	GW3	Ground Water	0.5 km E
4	Bore-well, Karanja	18°50'52.0"N	72°56' 41.4"E	GW4	Ground Water	1.9 km WNW
5	Bore-well, Pirwadi	18°51'29.9"N	72°55'27.6"E	GW5	Ground Water	0.3 km W
6	Kegaon Lake	18°53'05.1"N	72°54'57.9"E	SW1	Surface Water	2 km NW
7	Vimla Talao, Uran	18°52'42.1"N	72°56'09.2"E	SW2	Surface Water	0.6 km NE
8	Karanja Creek near mouth	18°50'20.5"N	72°56'31.5"E	Sea W1	Creek Water	2.3 km SE; ~0.7 km offshore
9	Off ONGC's Uran Plant	18°51'28.1"N	72°54'24.9"E	Sea W2	Sea Water	2.1 km W; ~1.75 km offshore

10	Off Kegaon	18°53'26.8"N	72°53'44.4"E	Sea W3	Sea Water	4 km NW; ~1.35 km Offshore
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Ground water and surface water samples were collected on 05-04-17. Sea and creek water samples were collected on 04-04-17. Sea and creek water samples were collected from ~0.6 m depth below the surface using "Van Dorn Type" water sampler.

3.9.3.2 Water Quality

The results of analysis of ground water are given in **Tables 3.17 and 3.18**.

**Table 3.17: Results of Ground Water Analysis during Summer, 2017
(Date of Sampling: 05-04-2017)**

Sl. No.	Parameters	Norms*		Results		
		Acceptable limits **	Permissible limits ***	GW1	GW2	GW3
1	Colour, Hazen Units. Max.	5	15	<5.0	<5.0	<5.0
2	Odour	Agreeable	-	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	-	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	1	5	<1	1	1
5	pH value	6.5 to 8.5	No relaxation	7.6	7.7	7.8
6	Total Hardness (as CaCO ₃), mg/l, max	200	600	232	436	452
7	Iron (as Fe), mg/l, max.	0.3	No relaxation	0.088	1.153	0.615
8	Chloride (as Cl), mg/l, max.	250	1000	92	184	228
9	Fluoride (as F), mg/l, max.	1	1.5	1.2	1.1	1.4
10	Dissolved Solids, mg/l, max.	500	2000	472	720	830
11	Calcium (as Ca), mg/l, max.	75	200	40	79	82
12	Magnesium (as Mg), mg/l, max.	30	100	32	58	60
13	Copper (as Cu), mg/l, max.	0.05	1.5	0.037	<0.01	<0.01
14	Manganese (as Mn), mg/l, max.	0.1	0.3	0.034	0.025	0.022
15	Sulphate (as SO ₄), mg/l, max.	200	400	21	34	17
16	Nitrate (as NO ₃), mg/l, max.	45	No relaxation	8.3	2.2	40.6
17	Phenolic compounds (as C ₆ H ₅ OH), mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001
18	Mercury (as Hg), mg/l, max.	0.001	No relaxation	<0.0005	<0.0005	<0.0005
19	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.01	<0.01	<0.01
20	Arsenic (as As), mg/l, max.	0.01	0.05	<0.03	<0.03	<0.03
21	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01	<0.01
22	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.01	<0.01	<0.01
23	Zinc (as Zn), mg/l, max.	5	15	0.277	0.463	<0.1
24	Total Chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01
25	Alkalinity(as CaCO ₃), mg/l	200	600	216	296	248

26	Aluminium (as Al), mg/l	0.03	0.2	<0.01	<0.01	0.105
27	Nickel (as Ni), mg/l	0.02	No relaxation	<0.01	<0.01	<0.01
28	Boron (as B), mg/l, Max.	0.5	1.0	<0.05	<0.05	<0.05

* Drinking Water Specification IS: 10500 (2012)

** Requirement (Acceptable limit)

*** Permissible limits in the absence of alternate source

**Table 3.18: Results of Ground Water Analysis during Summer, 2017
(Date of Sampling: 05-04-2017)**

Sl. No.	Parameters	Norms*		Results	
		Acceptable limits **	Permissible limits ***	GW4	GW5
1	Colour, Hazen Units. Max.	5	15	<5.0	<5.0
2	Odour	Agreeable	-	Agreeable	Agreeable
3	Taste	Agreeable	-	Non-Agreeable	Agreeable
4	Turbidity, NTU, Max.	1	5	1	<1
5	pH value	6.5 to 8.5	No relaxation	8.0	7.7
6	Total Hardness (as CaCO ₃), mg/l, max	200	600	5560	224
7	Iron (as Fe), mg/l, max.	0.3	No relaxation	0.326	0.342
8	Chloride (as Cl), mg/l, max.	250	1000	2300	744
9	Fluoride (as F), mg/l, max.	1	1.5	1.5	1.2
10	Dissolved Solids, mg/l, max.	500	2000	11780	1590
11	Calcium (as Ca), mg/l, max.	75	200	337	55
12	Magnesium (as Mg), mg/l, max.	30	100	1147	21
13	Copper (as Cu), mg/l, max.	0.05	1.5	<0.01	<0.01
14	Manganese (as Mn), mg/l, max.	0.1	0.3	0.012	0.02
15	Sulphate (as SO ₄), mg/l, max.	200	400	315	11
16	Nitrate (as NO ₃), mg/l, max.	45	No relaxation	1.6	1.2
17	Phenolic compounds (as C ₆ H ₅ OH), mg/l, max.	0.001	0.002	<0.001	<0.001
18	Mercury (as Hg), mg/l, max.	0.001	No relaxation	<0.0005	<0.0005
19	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.01	<0.01
20	Arsenic (as As), mg/l, max.	0.01	0.05	<0.03	<0.03
21	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01
22	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.01	<0.01
23	Zinc (as Zn), mg/l, max.	5	15	<0.1	<0.1
24	Total Chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.01	<0.01
25	Alkalinity (as CaCO ₃), mg/l	200	600	4600	140
26	Aluminium (as Al), mg/l	0.03	0.2	0.015	<0.01
27	Nickel (as Ni), mg/l	0.02	No relaxation	0.01	<0.01
28	Boron (as B), mg/l, Max.	0.5	1.0	<0.05	0.212

* Drinking Water Specification IS: 10500 (2012)

** Requirement (Acceptable limit)

*** Permissible limits in the absence of alternate source

The following can be seen from the results:

- ❖ All the ground water samples are “Hard”. At four of the five locations, Hardness exceeds the “Acceptable Limits” but is within the “Permissible Limits”. At the 5th location (Karanja) even the Permissible Limits has been exceeded.
- ❖ At four of the five locations, Alkalinity exceeds the “Acceptable Limits” but is within the “Permissible Limits”. At the 5th location (Karanja) even the Permissible Limits has been exceeded.
- ❖ Hardness and Alkalinity of water are due to presence of calcium and magnesium salts and this is reflected in the results. Ground water from Karanja contains excess of calcium and magnesium.
- ❖ At three of the five locations, Dissolved Solids exceeds the “Acceptable Limits” but is within the “Permissible Limits”. At one location (Nagaon), the Dissolved Solids content is within the Acceptable Limit but at the 5th location (Karanja) even the Permissible Limits has been exceeded.
- ❖ At Karanja, sea water has intruded into ground water in a major way as indicated by the very high chloride content (which is also reflected in the excessive dissolved solids content).
- ❖ Ground water from Karanja is totally unfit for drinking. At the other locations, the ground water may be used for drinking in absence of any other source.

The results of analysis of surface water are given in Table 3.19.

**Table 3.19: Results of Analysis of Surface Water
(Date of Sampling: 05-04-2017)**

Sl. No.	Parameters	SW1 (Kegaon Lake)	SW2 (Vimla Talao)
1	Colour, Hazen units	<5	<5
2	Turbidity, as NTU	5.0	5.0
3	pH Value	7.7	7.8
4	Dissolved Oxygen (as O ₂), mg/l	6.8	6.0
5	BOD, 3 days at 27° C, mg/l	2.0	3.0
6	Electrical Conductivity, μmhos/cm	824	958
7	Total Hardness (as CaCO ₃), mg/l	244	288
8	Iron (as Fe), mg/l	0.31	0.50
9	Chloride (as Cl), mg/l	149	220
10	Fluoride (as F) mg/l	0.9	1.4
11	Dissolved Solids mg/l	640	760
12	Calcium (as Ca), mg/l	43	51
13	Magnesium (as Mg), mg/L	33	39
14	Copper (as Cu), mg/l	<0.01	<0.01
15	Manganese (as Mn), mg/l	0.012	<0.01
16	Sulphate (as SO ₄), mg/l	25	61
17	Nitrate (as NO ₃), mg/l	5.3	9.7
18	Sodium (as Na), mg/l	90	120
19	Potassium (as K), mg/l	6	27

20	Mercury (as Hg), mg/l	<0.0005	<0.0005
21	Cadmium (as Cd), mg/l	<0.01	<0.01
22	Arsenic (as As), mg/l	<0.03	<0.03
23	Cyanide (as CN), mg/l	<0.01	<0.01
25	Lead (as Pb), mg/l	<0.01	<0.01
26	Zinc (as Zn), mg/l	<0.1	<0.1
27	Chromium (as Cr), mg/l	<0.01	<0.01
28	Alkalinity (as CaCO ₃) mg/l	220	224
29	Aluminium (as Al) mg/l	<0.02	<0.02
30	Coliform Organisms, MPN/100ml	320	410
31	Sodium Absorption Ratio	2.51	3.08
32	Free Ammonia (as N), mg/l	<0.01	<0.01
33	Boron (as B), mg/l	<0.05	0.073
34	Nickel (as Ni), mg/l	<0.01	<0.01

Vimla Talao is located in a public park in Uran town, whereas Kegaon lake is on the outskirts of the town. Both these fresh water bodies are located close to the coast and consequently chloride and dissolved solid levels are slightly elevated. Both water bodies appeared to be eutrophic as indicated by the greenish colour of the water. High coliform content also indicates sewage pollution.

The results of sea water analysis are given in **Table 3.20**. The results have been compared with the standards specified in Primary Water Quality Criteria for Designated Best Uses for Coastal Waters [As per "The Environment (Protection) Rules 1986 (as given in **Table 3.21**).

Table 3.20: Results of Analysis of Sea Water
(Date of Sampling: 04-04-2017)

Sl. No.	Parameter	Sea W1 (Karanja)	Sea W2 (Off Uran)	Sea W3 (Off Kegaon)
1	pH	7.8	7.9	7.7
2	Colour & Odour	<5	<5	<5
3	Dissolved Oxygen (as O ₂), mg/l	6	6.7	6.6
4	Turbidity, NTU	10	5	5
5	Oil & Grease, mg/l	15	17	11
6	Floating matters	Nil	Nil	Nil
7	Suspended Solids, mg/l	54	26	32
8	Lead (as Pb), mg/l	<0.01	<0.01	<0.01
9	Mercury (as Hg) mg/l	<0.0005	<0.0005	<0.0005
10	Cadmium (as Cd), mg/l	<0.01	<0.01	<0.01
11	Dissolved Iron (as Fe) mg/l	0.08	0.08	0.115
12	BOD, 3 days at 27° C, mg/l	3.0	2.0	2.0
13	Dissolved Manganese (as Mn), mg/l	0.01	<0.01	<0.01
14	Faecal Coliforms, MPN/100 ml	110	68	60
15	Sludge deposits, solid refuse, floating solids, oil & grease, scum	None observed	None observed	None observed

Table 3.21: Water Quality Criteria
A. Primary Water Quality Criteria for Designated Best Uses for Coastal Waters [As per “The Environment (Protection) Rules, 1986

Parameters	SW-1	SW-II	SW-III	SW-IV	SW-V
1. pH	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.0 – 9.0	6.0 – 9.0
2. Dissolved oxygen (as O ₂), mg/l, min	5 or 60% of saturation value, whichever is higher	4 or 50% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher
3. Colour & odour	No noticeable colour or offensive odour	No noticeable colour or offensive odour	No noticeable colour or offensive odour	No noticeable colour or offensive odour	None in such concentrations that would impair any usages specifically assigned to this class
4. Floating Matters	No visible, obnoxious floating debris, oil slick, scum	Nothing obnoxious or detrimental for use purpose	No visible, obnoxious floating debris, oil slick, scum	10 mg/l max. (including Oil & grease & scum / petroleum products)	-
5. Oil & grease (including petroleum products)	0.1 mg/l max.	-	-		-
6. Suspended solids	None from sewage & industrial origin	-	-	-	-
7. Heavy metals a) Mercury (as Hg) b) Lead (as Pb) c) Cadmium (as Cd)	0.001 mg/l 0.001 mg/l 0.01 mg/l	-	-	-	-
8. Turbidity, NTU max.	-	30	30	-	-
9. Faecal coliforms, MPN/100 ml, max	-	100	500	500	500
10. BOD, 3 days at 27° C, max	-	3 mg/l	-	5 mg/l	-
11. Dissolved Iron (as Fe)	-	-	0.5 mg/l max.	-	-
12. Dissolved Manganese (as Mn)	-	-	0.5 mg/l max.	-	-
13. Sludge deposits, solid refuse, floating solids, oil & grease, scum	-	-	-	-	None except for such small amount that may result from discharge of appropriately treated sewage & or industrial waste
SW-1 : Salt Pans, Shell fishing, mariculture and ecologically sensitive zone.; SW-III : Industrial Cooling, Recreation (non-contact) and aesthetics; SW-V : Navigation and Controlled Waste Disposal					
SW-II : Bathing, Contact Water Sports and Commercial Fishing SW-IV : Harbour Waters					

The water of Karanja Creek meets the quality criteria specified for “Industrial Cooling, Recreation (non-contact) and aesthetics” (SW III). It would have been suitable for “Bathing, Contact Water Sports and Commercial Fishing” (SW II) except for slightly higher Faecal Coliform Content. It may be noted that there are several settlements on the banks of this creek and it is likely sewage discharge from these settlements have contributed to the faecal coliform content of Karanja Creek.

Sea water off Pirwadi and off Kegaon is suitable for “Bathing, Contact Water Sports and Commercial Fishing” (SW II). However it was noted, that although no oil slick was visible on the surface at both these locations, there was some oil and grease at these locations (17mg/l off Pirwadi and 11mg/l off Kegaon). Dharmatar Creek, Karanja Creek as well as Thane Creek receive lots of urban run-offs and industrial effluents. These have contributed oil & grease to the water.

3.10 SOIL ENVIRONMENT

It is essential to determine the potential of soil in the area and identify the current impacts of urbanization and industrialization on soil quality and also predict impacts, which may arise due to the plant operations. Accordingly, a study of assessment of the baseline soil quality has been carried out.

3.10.1 DATA GENERATION

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The physical, chemical and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil up to a depth of 90 cm.

The present study of the soil profile establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the plant. The sampling locations have been identified with the following objectives:

- To determine the baseline soil characteristics of the study area;
- To determine the impact of industrialization on soil characteristics; and
- To determine the impact on soils more importantly from agricultural productivity point of view.

3.10.2 SOIL SAMPLE COLLECTION

To assess the quality of soil in study area, soil samples were collected from four locations during April, 2017. Table 3.22 lists the soil sampling locations. These locations are also marked in Fig. 3.6.

Table 3.22: List of Soil sampling Stations

Sample No.	Location	Latitude	Longitude	Type of Land
S1	Nagaon	18°52'28.4"N	72°55'43.1"E	Fallow Land
S2	Pirwadi	18°51'28.2"N	72°55'28.6"E	Mango Plantation
S3	Daurnagar	18°51'36.1"N	72°56'49.8"E	Agricultural Land
S4	Karanja (on Dronagiri hill)	18°51'01.2"N	72°56'34.4"E	Forest Land

The results of analysis are given in **Tables 3.23, 3.24, 3.25, and 3.26.**

Table 3.23: Physical Properties of Soil

Sample No.	Colour	Texture	Water Holding Capacity (%)	Bulk Density (g/cc)
S1	Blackish Brown	Sandy Silt	61	1.28
S2	Brownish Black	Silt	72	1.26
S3	Brownish Black	Silt	35	1.27
S4	Brown	Silt	51	1.29

Table 3.24: Chemical Properties of Soil

Parameters	S1	S2	S3	S4	S5
pH (1:5 Ratio)	7.8	7.5	7.2	7.6	7.8
Electrical Conductivity	329	80	115	93	329

Soil pH plays an important role in the availability of nutrients. Soil microbial activity is also dependent on pH. In the study area the soil pH is slightly alkaline ($7.8 < \text{pH} < 7.2$).

Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil. In the collected soil samples the conductivity ranged from 80 to 329s/cm.

Table 3.25: Available Major Nutrients in Soil

Parameters	S1	S2	S3	S4
Available Nitrogen (kg/ha) & Rating	201 Low	489 Medium	452 Medium	376 Medium
Available Phosphorus (Kg/ha) and Rating	2.4 Low	1.7 Low	2.1 Low	2.3 Low
Available Potassium (Kg/ha) and Rating	202 Medium	212 Medium	113 Low	84 Low
Organic carbon (%) and Rating	1.15 High	1.87 High	1.85 High	1.47 High
Organic Matter (%)	2.42	3.72	3.67	3.00

Rating based on:
Available Nitrogen <280 - Low; 280- 560 Medium; >560 - High Available
Phosphorus <10 - Low; 10 – 25 Medium; >25 - High Available Potassium
<120 - Low; 120 - 280 Medium; >280 - High. Organic carbon <0.50- Low;
0.5-0.75 Medium; > 0.75 - High

Phosphorus and Nitrogen are limiting nutrients, especially phosphorus. In the tested soil samples, availability of phosphorus is low in most samples. Availability of nitrogen was low in one sample (fallow land from Nagaon) but medium in the other three samples. Organic carbon is high in all four samples.

**Table 3.26: Soil Chemical constituents
(i) Exchangeable Cations**

Parameters	S1	S2	S3	S4
Calcium (meq/100gm)	45.60 (55.48)	37.80 (62.50)	30.81 (59.31)	38.05 (57.90)
Magnesium (meq/100gm)	35.38 (43.05)	22.01 (36.39)	20.37 (39.21)	27.16 (41.33)
Sodium (meq/100gm)	0.84 (1.02)	0.47 (0.78)	0.57 (1.10)	0.37 (0.56)
Potassium (meq/100gm)	0.37 (0.45)	0.20 (0.33)	0.20 (0.38)	0.14 (0.21)
Total Bases (meq/100gm)	82.19	60.48	51.95	65.72

Figures in () gives the % contribution of the respective ions to Base Saturation.

(ii) Soil micronutrients

Parameters	S1	S2	S3	S4
Copper	8.29	5.0	7.06	2.7
Zinc	5.53	2.46	2.03	2.16
Iron	26.97	49.22	61.44	32.90
Manganese	49.52	72.93	83.26	6.80
<i>Values in mg/ kg</i>				

The above results show that in all four tested soil samples calcium constitutes bulk of the exchangeable cations followed by magnesium whereas proportion of exchangeable sodium and potassium were low.

Soil micro-nutrients also play an important role in plant growth and can act as limiting nutrients. Even though the collected soil samples fall under the urban area and agriculture is not practised. Soil micro-nutrient analysis can be employed as a diagnostic tool for predicting the possibility of deficiency of a nutrient and the profitability of its application. For this, it is essential to fix the critical limits. The critical limit of micro-nutrient in a soil is that content of extractable nutrient at or below which plantation practiced on it will produce a

positive response to its application. The critical limits of copper, zinc and iron are 0.24-1.33 mg/kg, 0.18-12.0 mg/kg and 0.38-3.32 mg/kg respectively. Excess of one more micro-nutrients can slow down the uptake of other micro-nutrients due to the antagonistic effect. Excess of copper affects uptake of Molybdenum, another micro-nutrient. Excess of Zinc, Manganese and Copper affect Iron uptake. Excess Iron, Copper and Zinc affect Manganese uptake. This can improve soil fertility by neutralizing the effect of some excess micro-nutrients or can reduce soil fertility by blocking uptake of critically needed micro-nutrients. From the above Table it can be seen that in all of the four samples copper as well as iron levels are higher than the critical limits.

3.11 BIOLOGICAL ENVIRONMENT

Ecological studies are one of the important aspects of Environmental Impact Assessment with a view to conserve environmental quality and biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the abiotic components viz. physical and chemical components of the environment.

Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important in Environmental Impact Assessment for safety of natural flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

The animal and plant communities co-exist in a well-organized manner. Their natural settings can get disturbed by any externally induced anthropological activities or by naturally occurring calamities or disaster. So, once this setting is disturbed, it sometimes is either practically impossible or may take a longer time to come back to its original state. Hence changes in the status of flora and fauna are an elementary requirement of Environmental Impact Assessment studies, in view of the need for conservation of environmental quality and biodiversity. Information on flora and fauna was collected within the study area.

3.11.1 Objectives of Ecological Studies

The objective of the present study was undertaken with a view to understand the present ecosystem on the following lines:

- To assess the distribution of vegetation in and around the proposed plant;
- To assess the distribution of animal life in the proposed plant areas as well as surrounding areas;
- To assess the biodiversity and to understand the resource potential; and
- To understand the nature of pollution and the impact of pollution on the ecosystem.

3.11.2 Methodology Adopted for the Survey

To achieve above objectives a detailed study of the area was undertaken in 10-km radius area with the proposed project site as its centre. The different methods adopted were as follows:

- Compilation of secondary data with respect to the study area from published literature and Government agencies;
- Generation of first hand data by undertaking systematic ecological studies in the area;
- Interrogating local people so as to elicit information for local plants, animals and their uses

The present report gives the review of published secondary data and the results of field sampling conducted during January-March, 2018. Different land use/ land cover surrounding the proposed site are given below.

3.11.3 Ecology

The study area is located on the eastern shore of the Arabian Sea. About half the study area is covered by the sea. The terrestrial part of the study area comprises of rural & urban settlements, industrial lands, waste lands, mangroves, surface water bodies, marshy areas, forests, agricultural land etc.

Ecology of the area was studied by actual field studies / observations and collecting information from published literature [particularly the book "Flora of Raigad District, Maharashtra State by M.J. Kothari & S. Moorthy (Pub. Botanical survey of India, 1993) and MMR Biodiversity Project – Final Report A Project by Yuhina EcoMedia Sponsored by MMR-EIS] and augmented by field survey.

3.11.3.1 Terrestrial Ecology

The landward part of study area is partly urban and partly rural. The rural areas comprises of forests (only on the hill), tidal creeks & marshy areas, agricultural land, waste / barren lands and rural settlements.

Project Area Flora

At the site of the proposed project, the vegetation comprises of some coconut palms and bottle palms which form part of the plant's plantation areas, some *Zizyphus* trees and saplings of peepal (*Ficus religiosa*), banyan (*Ficus bengalensis*) other figs (*Ficus spp.*), *Tridax procumbens* and some grasses are found growing on the road side.

Project Area Fauna

Since the project area is located inside a major industrial plant, there are no animals except some common birds.

Study Area Flora

The terrestrial part of the study area comprises of rural & urban settlements, industrial lands, waste lands, mangroves, surface water bodies, marshy areas, forests, agricultural land etc.

The plants found naturally in the study area are listed in **Table 3.27**.

Table 3.27: List of Plants Found in the Study Area

Sl. No.	Local Name	Scientific Name	Family
Trees			
1.	Khair	Acacia catechu	Mimosaceae
2.	Lal-khair	Acacia chundra	Mimosaceae
3.	Babool	Acacia nilotica	Mimosaceae
4.	Bael	Aegle marmelos	Rutaceae
5.	Marukh	Ailanthus excelsa	Simarubiaceae
6.	Akola	Alangium salvifolium	Alanginaceae
7.	Lallei	Albizzia amara	Mimosaceae
8.	Shirish	Albizzia lebbeck	Mimosaceae
9.	Dhavada	Anogeissus latifolia	Combretaceae
10.	Tivar	Avicennia marina	Avicenniaceae
11.	Tivar	Avicennia officinalis	Avicenniaceae
12.	Neem, Kadulimb	Azadirachta indica	Meliaceae
13.	Amlī	Bauhinia malabarica	Caesalpiniaceae
14.	Savar	Bombax ceiba	Bombacaceae
15.	Taad	Borassus flabellifer	Arecaceae
16.	Asana	Bridelia retusa	Euphorbiaceae
17.	Kandel	Bruguiera cylindrica	Rhizophoraceae
18.	Bherali mad	Caryota urens	Arecaceae
19.	Bahava	Cassia fistula	Caesalpiniaceae
20.	Kassod	Cassia siamea	Caesalpiniaceae
21.	Suru	Casurina litorea	Casurinaceae
22.	-	Cerriops tagal	Rhizophoraceae
23.	Bheru, Halda	Chloroxylon swietenia	Meliaceae
24.	Narali	Cocos nucifera	Arecaceae
25.	Fashi	Dalbergia paniculata	Fabaceae
26.	Shisham	Dalbergia sissoo	Fabaceae
27.	Pangara	Erythrina variegata	Fabaceae
28.	Geva	Excoecaria agallocha	Euphorbiaceae
29.	Vad	Ficus bengalensis	Moraceae
30.	Bokhada	Ficus hispida	Moraceae

31.	Pimpal	<i>Ficus religiosa</i>	Moraceae
32.	Bassari	<i>Ficus virens</i>	Moraceae
33.	Khavashi	<i>Firmiana colorata</i>	Sterculiaceae
34.	Dikemal	<i>Gardenia resinifera</i>	Rubiaceae
35.	Kakad	<i>Garuga pinnata</i>	Burseraceae
36.	Dhaman	<i>Grewia tiliaefolia</i>	Tiliaceae
37.	Kaori	<i>Grewia serrulata</i>	Tiliaceae
38.	Varas	<i>Heterophragma quadriloculare</i>	Bignoniaceae
39.	Sirid	<i>Hymenodictyon excelsum</i>	Rubiaceae
40.	-	<i>Ixora arborea</i>	Rubiaceae
41.	Lokhandi	<i>Ixora brachiata</i>	Rubiaceae
42.	Lende	<i>Lagerstroemia parviflora</i>	Lythraceae
43.	Moine	<i>Lannea coromandelica</i>	Anacardiaceae
44.	Humb	<i>Miliusa tomentosa</i>	Annonaceae
45.	Kalam	<i>Mitragyna parviflora</i>	Rubiaceae
46.	Dhuala	<i>Morinda pubescens</i>	Rubiaceae
47.	Kadipatta	<i>Murraya koenigii</i>	Rutaceae
48.	Shindi	<i>Phoenix sylvestris</i>	Palmae
49.	Karanj	<i>Pongamia pinnata</i>	Fabaceae
50.	-	<i>Prosopis juliflora</i>	Fabaceae
51.	Kamodumbi	<i>Rhizophora mucronata</i>	Rhizophoraceae
52.	Koshimb	<i>Schleichera oleosa</i>	Sapindaceae
53.	Bibba	<i>Semecarpus anacardium</i>	Anacardiaceae
54.	Chipi	<i>Sonneratia apetala</i>	Sonneratiaceae
55.	-	<i>Sonneratia caseolaris</i>	Sonneratiaceae
56.	Kahandol	<i>Sterculia urens</i>	Sterculiaceae
57.	Jambhul	<i>Syzygium cuminii</i>	Myrtaceae
58.	Chincha	<i>Tamarindus indica</i>	Caesalpiniaceae
59.	-	<i>Tamarix troupii</i>	Tamaricaceae
60.	Bhendi	<i>Thespesia populnea</i>	Malvaceae
61.	Kala-kuda	<i>Wrightia tinctoria</i>	Apocynaceae
62.	Yerul	<i>Xylia xylocarpa</i>	Mimosaceae
63.	Bor	<i>Zizyphus mauritiana</i>	Rhamnaceae
64.	Katbor	<i>Zizyphus xylopyrus</i>	Rhamnaceae
Shrub			
1.	-	<i>Acacia rugata</i>	Caesalpiniaceae
2.	Theepani	<i>Allophylus cobbe</i>	Sapindaceae
3.	Raan-bhendi	<i>Azanza lampas</i>	Malvaceae
4.	Koranti	<i>Barleria spp.</i>	Acanthaceae
5.	Rui	<i>Calotropis gigantea</i>	Asclepiadaceae
6.	Ukshi	<i>Calycopteris floribunda</i>	Combretaceae
7.	Kanther	<i>Capparis sepiaria</i>	Capparidaceae
8.	Govindphal	<i>Capparis zeylanica</i>	Capparidaceae
9.	Pingawi	<i>Celastrus paniculatus</i>	Celastraceae
10.	Pahadvel	<i>Cissamplelos pareira</i>	Menispermaceae
11.	-	<i>Cissus spp.</i>	Vitaceae
12.	Koyanel	<i>Clerodendrum inerme</i>	Verbenaceae

13.	Kavali	<i>Cryptolepis buchananii</i>	Periplocaceae
14.	-	<i>Dalbergia horrida</i>	Fabaceae
15.	Dhotara	<i>Datura metel</i>	Solanaceae
16.	Kirmith	<i>Grewia abutilifolia</i>	Tiliaceae
17.	Anantmul	<i>Hemidesmus indicus</i>	Periplocaceae
18.	Besharam	<i>Ipomea carnea</i>	Convolvulaceae
19.	-	<i>Ixora coccinea</i>	Rubiaceae
20.	Mogra	<i>Jasminum spp.</i>	Oleaceae
21.	Mogli-erand	<i>Jatropha curcas</i>	Euphorbiaceae
22.	-	<i>Jatropha gossypifolia</i>	Euphorbiaceae
23.	Ghaneri	<i>Lantana camara</i>	Verbenaceae
24.	-	<i>Leea spp.</i>	Leeaceae
25.	-	<i>Pavetta spp</i>	Rubiaceae
26.	Surati earand	<i>Ricinus communis</i>	Euphorbiaceae
27.	Pilu	<i>Salvadora persica</i>	Salvadoraceae
28.	-	<i>Solanum anquivi</i>	Solanaceae
29.	Kadsherni	<i>Tamarix ericoides</i>	Tamaricaceae
30.	Unhali	<i>Tephrosia spp.</i>	Fabaceae
31.	Pan-kanis	<i>Typha angustifolia</i>	Typhaceae
32.	Hadmodi	<i>Viscum articulatum</i>	Loranthaceae
33.	Burgi	<i>Zizyphus oenopila</i>	Rhamnaceae
Herbs			
1.	Petari	<i>Abutilon indicum</i>	Malvaceae
2.	Marandi	<i>Acanthus ilicifolius</i>	Acanthaceae
3.	Aghada	<i>Achyranthes aspera</i>	Amaranthaceae
4.	Kajala	<i>Aegiceras corniculatus</i>	Myrsinaceae
5.	-	<i>Alysicarpus spp.</i>	Fabaceae
6.	Pivala-dhotara	<i>Argemone mexicana</i>	Papavaraceae
7.	-	<i>Atylosia scarabaeoides</i>	Fabaceae
8.	-	<i>Bidens biternata</i>	Asteraceae
9.	Lajwanti	<i>Biophytum sensitivum</i>	Oxalidaceae
10.	Kate-maka	<i>Blepharis repens</i>	Acanthaceae
11.	-	<i>Blumea spp.</i>	Asteraceae
12.	Punarnava	<i>Boerhavia diffusa</i>	Nyctaginaceae
13.	-	<i>Borreria spp.</i>	Rubiaceae
14.	-	<i>Cassia spp.</i>	Caesalpiniaceae
15.	-	<i>Centranther spp.</i>	Scrophulariaceae
16.	Chakvat	<i>Chenopodium album</i>	Chenopodiaceae
17.	-	<i>Clitora spp.</i>	Fabaceae
18.	Tondali	<i>Coccinia grandis</i>	Cucurbitaceae
19.	Vasanvel	<i>Cocculus hirsutus</i>	Menispermaceae
20.	-	<i>Corchorus sps.</i>	Tiliaceae
21.	Lona, Rudravanti	<i>Cressa cretica</i>	Convolvulaceae
22.	-	<i>Crotalaria spp.</i>	Fabaceae
23.	-	<i>Curcuma decipiens</i>	Zingiberaceae
24.	-	<i>Cyperus spp.</i>	Cyperaceae
25.	-	<i>Desmodium spp.</i>	Fabaceae
26.	Dashmuli	<i>Eranthemum roseum</i>	Acanthaceae

27.	Dudhi	Euphorbia hirta	Euphorbiaceae
28.	Vishnukranta	Evolvulus alsonoides	Convolvulaceae
29.	-	Fimbristylis spp.	Cyperaceae
30.	-	Flemingia tuberosa	Fabaceae
31.	Nila-jakara	Haplanthodes tentaculata	Acanthaceae
32.	Jaungali-tulas	Hyptis suaveolens	Lamiaceae
33.	-	Impatiens spp.	Balsaminaceae
34.	-	Indigofera spp.	Fabaceae
35.	Nadishaka	Ipomea aquatica	Convolvulaceae
36.	-	Justicia spp.	Acanthaceae
37.	Pathari	Launaea procumbens	Asteraceae
38.	Safed dindya	Leea macrophylla	Leeaceae
39.	Deepmal	Leonotis nepetefolia	Lamiaceae
40.	-	Lindernia spp.	Scrophulariaceae
41.	-	Lippia nodiflora	Verbenaceae
42.	Winchavi	Martynia annua	Martyniaceae
43.	Lajalu	Mimosa pudica	Mimosaceae
44.	-	Mitreola petiolata	Spigeliaceae
45.	-	Neanotis spp.	Rubiaceae
46.	Nilgonda	Neuracanthus sphaerostachys	Acanthaceae
47.	-	Oldenlandia spp.	Rubiaceae
48.	Gajargavat	Parthenium hysterophorus	Asteraceae
49.	-	Polygala elongata	Polygalaceae
50.	Ghol	Portulaca oleracea	Portulacaceae
51.	-	Pseudarthria viscida	Fabaceae
52.	-	Rotala spp.	Lythraceae
53.	Wayati	Ruellia tuberosa	Acanthaceae
54.	Sut	Rungia pectinata	Acanthaceae
55.	Bhuiavali	Sesbania bispinosa	Fabaceae
56.	-	Sida sps.	Malvaceae
57.	-	Smithia spp.	Fabaceae
58.	-	Solanum spp.	Solanaceae
59.	-	Suaeda monoica	Chenodiaceae
60.	-	Synedrella nodiflora	Asteraceae
61.	Dagadpala	Tridax procumbens	Asteraceae
62.	-	Triumfetta spp.	Tiliaceae
63.	Vanbhnedi	Urena lobata	Malvaceae
64.	-	Vernonia spp	Asteraceae
65.	-	Vigna spp.	Fabaceae
66.	Ghagara, Shankeshrvar	Xanthium indicum	Asteraceae
Climber			
1.	Gunj	Abrus precatorius	Fabaceae
2.	Shembi	Acacia pennata	Mimosaceae
3.	Ran draksha	Ampelocissus latifolia	Vitaceae
4.	Bokadvel	Aspidopteris cordata	Malpighiaceae
5.	Amarvel	Cassytha filiformis	Lauraceae

6.	-	Cayratia spp.	Vitaceae
7.	-	Ceropegia spp.	Asclepiadaceae
8.	Gokarna	Clitoria ternate	Fabaceae
9.	Piluki	Combretum ovalifolium	Combretaceae
10.	Amarvel	Cuscuta reflexa	Cuscutaceae
11.	Thorali Padval	Cyclea peltata	Menispermaceae
12.	Alai	Dalbergia volubilis	Fabaceae
13.	Garudvel	Derris scandens	Fabaceae
14.	Lal-pungali	Ipomea hederifolia	Convolvulaceae
15.	Maryadavel	Ipomea pes-caprae	Convolvulaceae
16.	Vishnukranti	Ipomea quamoclit	Convolvulaceae
17.	-	Melothria spp.	Cucurbitaceae
18.	Khajkujali	Mucuna pruriens	Fabaceae
19.	Vidarikanda	Pueraria tuberosa	Fabaceae
20.	Gulvel	Tinospora cordifolia	Menispermaceae
21.	Ran padwal	Trichosanthes cucumerina	Cucurbitaceae
Bamboo			
1.	Udha	Dendrocalamus strictus	Poaceae
Grasses			
1.	Dola-gavat	Aelurops spp.	Poaceae
2.	-	Bothriochloa spp	Poaceae
3.	Durva	Cynodon dactylon	Poaceae
4.	Makda	Dactyloctenium aegypticum	Poaceae
5.	-	Dicanthium spp.	Poaceae
6.	-	Eragrostis spp.	Poaceae
7.	-	Eriochloa spp.	Poaceae
8.	-	Ischaemum spp.	Poaceae
9.	-	Oplismenus spp.	Poaceae
10.	-	Perotis spp.	Poaceae
11.	-	Panicum spp.	Poaceae
12.	-	Spinifex littoreus	Poaceae
Source: Book "Flora of Raigad District, Maharashtra State by M.J. Kothari & S. Moorthy (Pub.Botanical survey of India, 1993) augmented by field survey			

The terrestrial part of study area comprises of urban as well as rural areas. Most of the area is plain. However there a massive forested escarpment, Dronagiri Hill on the eastern side of the plant. The lower slopes of Dronagiri Hill and the top of the ridge are forested. There is stretch of near vertical rock cliff just below the top of the ridge. Another ~2 km long hill extending in the north-east–south-west direction is located ~2.5 km north of the project site. The vegetation on this hill is sparse.

Study Area Fauna

The animals found in the study area are listed in **Table 3.28**.

Table 3.28: List of Terrestrial Animals found in the Study Area

Sl. No.	Common Name	Scientific Name	Schedule of Wild Life Protection Act in Which Listed
Mammals			
1.	Common Mongoose	<i>Herpestres edwardsii</i>	II
2.	Jackal	<i>Canis aureus</i>	II
3.	Indian Fox	<i>Vulpes bengalensis</i>	II
4.	Common house rat	<i>Rattus rattus</i>	V
5.	Common House Mouse	<i>Mus musculus</i>	V
6.	Indian Field Mouse	<i>Mus booduga</i>	V
7.	Bandicoot Rat	<i>Bandicota indica</i>	V
8.	Common House Shrew	<i>Suncus murinus</i>	-
9.	Rhesus Macaque	<i>Macaca mulatta</i>	II
10.	Bonnet Macaque	<i>Macaca radiata</i>	II
11.	Squirrel	<i>Funambulus pennanti</i>	IV
12.	Fulvous fruit bat	<i>Rousettus leschnaulti</i>	V
13.	Jungle Cat	<i>Felis chaus</i>	II
14.	Hare	<i>Lepus nigricollis</i>	IV
15.	3-Striped Palm Squirrel	<i>Funambulus palmarum</i>	IV
16.	Common civet	<i>Viverricula indica</i>	II
17.	Indian Flying Fox	<i>Pteropus giganteus</i>	-
18.	Greater Nosed Fruit Bat	<i>Cynopterus sphinx</i>	V
19.	Schneider's Leaf-Nosed Bat	<i>Hipposideros speoris</i>	-
20.	Indian Pipistrelle	<i>Pipistrellus coromandra</i>	-
21.	Wild Pig	<i>Sus scrofa</i>	III
Reptiles			
1.	Yellow Rat Snake	<i>Ptyas mucosus</i>	II
2.	Cobra	<i>Naja naja</i>	II
3.	Common Krait	<i>Bungarus caeruleus</i>	IV
4.	Russel's Viper	<i>Daboia russelii</i>	II
5.	Trinket Snake	<i>Coelognathus helena</i>	IV
6.	Indian Python	<i>Python molurus</i>	I
7.	Green Tree Snake	<i>Ahaetula nasuta</i>	IV
8.	Kukri Snake	<i>Oligodon spp.</i>	IV
9.	Striped Keelback	<i>Amphiesma stolatium</i>	IV
10.	Checkered Keelback	<i>Xenochrophis piscator</i>	II
11.	Common Bronzeback Tree Snake	<i>Dendrelaphis tristis</i>	IV
12.	Brahminy Worm Snake	<i>Ramphotyphlops braminus</i>	IV
13.	Beaked worm snake	<i>Gryphotyphlops acutus</i>	IV
14.	Wolf Snake	<i>Lycodon spp.</i>	IV

15.	Cat Snake	<i>Boiga spp.</i>	IV
16.	Garden Lizard	<i>Calotes versicolor</i>	-
17.	Grass Skink	<i>Eutropis spp.</i>	II
18.	House Gecko	<i>Hemidactylus spp.</i>	-
19.	Snake Skink	<i>Lygosoma punctatum</i>	-
20.	Monitor Lizard	<i>Varanus bengalensis</i>	I
Birds			
1	Pariah Kite	<i>Milvus migrans</i>	-
2	Common Crow	<i>Corvus splendens</i>	V
3	Jungle Crow	<i>Corvus marorrhynchus</i>	IV
4	House Sparrow	<i>Passer domesticus</i>	-
5	Grey Wagtail	<i>Motacilla cinerea</i>	IV
6	Common Tailorbird	<i>Orthotomus sutorius</i>	IV
7	Drongo	<i>Dicrurus adsimilis</i>	IV
8	Crow Pheasant	<i>Centropus sinensis</i>	IV
9	Black-winged Kite	<i>Elanus caeruleus</i>	IV
10	Weaver Bird	<i>Ploceus philippinus</i>	IV
11	Red Whiskered Bulbul	<i>Pycnonotus jocosus</i>	IV
12	Red Vent Bulbul	<i>Pycnonotus cafer</i>	IV
13	White-eared Bulbul	<i>Pycnonotus leucotis</i>	IV
14	Koel	<i>Eudynamis scolopacea</i>	IV
15	Grey Bellied Cuckoo	<i>Coccomantis passerinus</i>	IV
16	Banded Bay Cuckoo	<i>Coccomantis sonneratii</i>	IV
17	Pegion	<i>Columba livia</i>	IV
18	Spotted Dove	<i>Streptopelia chinensis</i>	IV
19	Collared Dove	<i>Streptopelia decaocto</i>	IV
20	Flamingo	<i>Phoenicopterus roseus</i>	IV
21	Lesser Flamingo	<i>Phoeniconaias minor</i>	IV
22	Indian Robin	<i>Saxicoloides fulicata</i>	IV
23	House Swift	<i>Apus affinis</i>	IV
24	Green Bee-eater	<i>Merops orientalis</i>	IV
25	Shikra	<i>Accipiter badius</i>	IV
26	Scaly Breasted Munia	<i>Lonchura punctulata</i>	IV
27	Black Headed Munia	<i>Lonchura malacca</i>	IV
28	Purple Sunbird	<i>Nectarinia asiatica</i>	IV
29	Purple Rumped Sunbird	<i>Leptocoma zeylonica</i>	IV
30	Ashy Prinia	<i>Prinia socialis</i>	IV
31	Grey Breasted Prinia	<i>Prinia hodgsonii</i>	IV
32	Red Wattled Lapwing	<i>Vannellus indica</i>	IV
33	Rose Ringed Parakeet	<i>Psittacula krameri</i>	IV
34	Common Moorhen	<i>Gallinula chloropus</i>	IV
35	Tawny Pitpit	<i>Anthus campestris</i>	IV
36	Magpie Robin	<i>Copsychus saularis</i>	IV
37	Long Tailed Shrike	<i>Lanius schach</i>	IV
38	Brown Shrike	<i>Lanius cristatus</i>	IV
39	Wire Tailed Swallow	<i>Hirundo smithii</i>	IV
40	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	IV
41	Crow Pheasant	<i>Centropus sinensis</i>	IV

42	Greater Sand Plover	<i>Charadius leschenaulti</i>	IV
43	Lesser Sand Plover	<i>Charadius mongolus</i>	IV
44	Little Ringed Plover	<i>Charadius dubius</i>	IV
45	Indian Whiskered Tern	<i>Chilodonia hybrida</i>	IV
46	Little Tern	<i>Sterna albifrons</i>	IV
47	Black-winged stilt	<i>Himantopus himantopus</i>	IV
48	Avocet	<i>Recurvirostra avosetta</i>	IV
49	Minivet	<i>Pericrocotus spp.</i>	IV
50	Common Iora	<i>Aegithina tiphia</i>	IV
51	Brahminy Kite	<i>Haliastur indus</i>	IV
52	Black-winged Kite	<i>Elanus caeruleus</i>	IV
53	Turnstone	<i>Arenaria interpres</i>	IV
54	Indian Tree-pie	<i>Dendrocitta vagabunda</i>	IV
55	Pied Mynah	<i>Sturnus contra</i>	IV
56	Common Mynah	<i>Acridotheres tristis</i>	IV
57	Jungle Mynah	<i>Acridotheres fuscus</i>	IV
58	White Breasted Kingfisher	<i>Halcyon smyrnensis</i>	IV
59	Intermediate Egret	<i>Egretta intermedia</i>	IV
60	Cattle Egret	<i>Bubulcus ibis</i>	IV
61	Little Egret	<i>Egretta garzetta</i>	IV
62	Common Sandpiper	<i>Tringa hypoleucos</i>	IV
63	Pond Heron	<i>Ardeola grayii</i>	IV
64	Night Heron	<i>Nycticorax nycticorax</i>	IV
65	Grey Heron	<i>Ardea cinerea</i>	IV
67	Small Indian Cormorant	<i>Phalacrocorax niger</i>	IV
68	Indian Shag	<i>Phalacrocorax fuscicollis</i>	IV
69	Indian Reef Heron	<i>Egretta gularis</i>	IV
70	Coppersmith barbet	<i>Megalaima viridis</i>	IV
71	White-Eye	<i>Zosterops palpebrosa</i>	IV
72	Ruddy Shelduck	<i>Tadorna ferruginea</i>	IV
73	Common Teal	<i>Anas crecca</i>	IV
74	Wigeon	<i>Anas penelope</i>	IV
75	Northern Shoveller Duck	<i>Anas clypeata</i>	IV
76	Glossy ibis	<i>Plegadis falcinellus</i>	IV
77	White breasted water-hen	<i>Amaurornis phoenicurus</i>	IV
78	Common Barn Owl	<i>Tyto alba</i>	IV
79	Spotted Owlet	<i>Athene brama</i>	IV
80	Buzzard	<i>Buteo spp.</i>	IV
81	Tawny Eagle	<i>Aquila rapax</i>	IV
82	Harrier	<i>Circus spp.</i>	IV
83	White Spotted Fantail Flycatcher	<i>Rhipidura albogularis</i>	IV
84	Indian Robin	<i>Saxicoloides fulicatus</i>	IV
85	Common Stonechat	<i>Saxicola torquatus</i>	IV
86	Great Black Headed Gull	<i>Larus ichthyaetus</i>	IV
87	Brown Headed Gull	<i>Larus brunnicephalus</i>	IV
88	Common Black Headed Gull	<i>Larus ridibundus</i>	IV
89	Slender Billed Gull	<i>Larus genei</i>	IV

90	Black Tailed Godwit	<i>Limosa limosa</i>	IV
91	Bar Tailed Godwit	<i>Limosa lapponica</i>	IV
92	Jungle Babbler	<i>Turdoides striatus</i>	IV
93	Ruddy Turnstone	<i>Arenaria interpres</i>	IV
94	Curlew Sandpiper	<i>Calidris ferruginea</i>	IV
95	Little Stint	<i>Calidris minuta</i>	IV
96	Greater Painted Snipe	<i>Rostratula benghalensis</i>	IV
97	Common Snipe	<i>Gallinago gallinago</i>	IV
98	Pintail Snipe	<i>Gallinago stenura</i>	IV
99	Red Breasted Flycatcher	<i>Fidcula parva</i>	IV
100	Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>	IV
101	Grasshopper Warbler	<i>Locustella naevia</i>	IV
102	Reed Warbler	<i>Acrocephalus spp.</i>	IV
103	Booted Warbler	<i>Hippolais caligata</i>	IV

Sources: MMR BIODIVERSITY PROJECT – FINAL REPORT A Project by Yuhina EcoMedia
Sponsored by MMR-EIS augmented by field survey

In most of the study area, due to lack of suitable habitat diversity of animals is low. The forest on Dronagiri Hill is good wildlife habitat but it has no permanent large surface water body and moreover it is an isolated patch and surrounded by human settlements and industries.

3.12 SOCIO ECONOMIC ENVIRONMENT

3.12.1 Introduction

Baseline data for demographic characteristics, education, health, amenities for locations existing around the project area have been examined to assess the socio-economic status for the proposed project.

The proposed modernisation project of the facilities within the existing major port is expected to introduce a set of new activities, which may influence socio-economic condition of the people of the area surrounding it. Such impacts may be marginal or non-marginal depending on the extent of change caused by the project to alter the existing equilibrium of the socio-economic system. The present project is likely to bring benefits for the local people. However, possibility of certain obvious hardships having social cost cannot also be ruled out.

With this background, the present socio-economic impact assessment of the project has been carried out with respect to the following objectives:

- To assess the impact of the project on the pattern of demand;
- To estimate employment and income effects of the project;
- To ascertain the impact of the project on the consumption behaviour;
- To explore the impact of the project on educational status;
- To analyse peoples' perception regarding impact of the project.

3.12.1 Brief Outline of the Study Area

As stated earlier, the study area (10 km radius area) covers 310.6 sq. km around the project site, of which 50.25% is within the sea.

The entire study area falls under Raigad district of Maharashtra. Basic statistics of the study area are given in **Table 3.29**.

Table 3.29: Basic statistics of Study Area

Sl. No	Item	Unit	Study Area
1	Population Total Male Female	Nos.	105444
			55037
			50407
2	Sex Ratio	Female / 1000 Males	915.87
3	SC	Nos.	4571
4	ST	Nos.	5490
5	Literacy rate	%	75.63
6	Total main workers	Nos.	32339
7	Occupational pattern of the main work force Cultivators Agricultural labourers Household industry Others	Nos.	2384
			1548
			1156
			27251
8	Marginal workers		9032

Source :Census 2011

Total population of the study area as recorded in 2011 census is 1,05,444. The sex ratio in the study area (915.87 females per 1000 males) is lower than the national average (943). SC and ST categories constitute ~4.3% and ~5.2% of the population respectively. Literacy rate is ~75.6%. Working population constitute 39.24% of the total population. Main and marginal workers constitute 30.67% and 8.57% of total population respectively. It may be noted that of that ~84.3% of the main workers are classified as "Other Main Workers" i.e. they are mostly engaged in industry, services, commerce and other allied activities. The few thousand people engaged in agricultural activities work some of the plantations north of the plant and crop lands come from the eastern fringes of the study area. Details of village / town - wise demographic pattern of the study area are given in **Table 3.30**.

Table 3.30: detaild village/town wise demographic pattern

Sl. No.	Village / Town	No. of Household	Total Population	Total Male	Total Female	SC	ST	Literate	Male Literate	Female Literate	Illiterate	Male Illiterate	Female Illiterate	Working Population	Main Worker	Main Cultivator	Main Agri-worker	Main Household Industry	Main Others	Marginal Worker	Non Working population
1	Gharapuri	154	647	318	329	1	5	492	265	227	155	53	102	470	459	11	0	98	350	11	177
2	Juna Sheva	1	7	3	4	0	0	6	3	3	1	0	1	4	2	0	0	0	2	2	3
3	Sonari	510	2214	1130	1084	13	0	1781	953	828	433	177	256	855	688	16	14	41	617	167	1359
4	Sawarkhar	396	1481	818	663	3	9	1105	646	459	376	172	204	522	502	11	2	5	484	20	959
5	Pagote	371	1664	865	799	38	23	1294	699	595	370	166	204	587	565	31	5	49	480	22	1077
6	Karal	393	1374	747	627	26	6	1041	575	466	333	172	161	462	454	4	2	2	446	8	912
7	Jaskhar	832	3219	1699	1520	128	60	2520	1412	1108	699	287	412	1068	961	28	31	42	860	107	2151
8	Panje	270	1268	646	622	0	0	988	531	457	280	115	165	381	298	5	0	3	290	83	887
9	Dongari	301	1223	631	592	0	0	1023	557	466	200	74	126	393	350	13	4	18	315	43	830
10	Hanuman Koliwada	277	1285	651	634	16	654	938	515	423	347	136	211	431	355	8	0	3	344	76	854
11	Ranwad	456	1885	975	910	100	19	1587	842	745	298	133	165	605	555	21	13	18	503	50	1280
12	Boripakhadi	306	1348	700	648	70	231	905	490	415	443	210	233	543	471	9	5	15	442	72	805
13	Kaladhonda	614	2697	1391	1306	229	122	2146	1152	994	551	239	312	1073	797	33	98	25	641	276	1624
14	Bokadvira	679	2810	1492	1318	122	32	2191	1228	963	619	264	355	931	816	28	18	10	760	115	1879
15	Funde	390	1516	782	734	7	1	1151	633	518	365	149	216	515	410	15	2	10	383	105	1001
16	Bhendkhal	806	3201	1680	1521	155	103	2522	1384	1138	679	296	383	1154	1019	89	10	28	892	135	2047
17	Navin Sheva	651	2781	1459	1322	98	44	2048	1147	901	733	312	421	1027	915	19	13	41	842	112	1754
18	Mhatwali	796	3304	1725	1579	239	31	2608	1423	1185	696	302	394	1480	1333	58	23	16	1236	147	1824
19	Nagaon	932	3837	2013	1824	336	229	3019	1648	1371	818	365	453	1321	1147	37	11	61	1038	174	2516
20	Belondakhar	175	795	381	414	12	0	594	302	292	201	79	122	210	209	114	4	1	90	1	585
21	Muthekhar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Waltikhar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

23	Bori Bk.	185	836	426	410	5	0	599	331	268	237	95	142	423	191	154	7	6	24	232	413
24	Boricha Kotha	2	7	3	4	0	0	7	3	4	0	0	0	7	0	0	0	0	0	7	0
25	Dhasakhosi	118	482	245	237	0	0	356	201	155	126	44	82	190	153	4	7	6	136	37	292
26	Jui	635	3115	1570	1545	0	109	2141	1204	937	974	366	608	1100	630	102	52	25	451	470	2015
27	Koprol	764	3123	1583	1540	14	428	2319	1261	1058	804	322	482	1189	834	101	110	36	587	355	1934
28	Bandhpada	380	1649	853	796	1	35	1324	733	591	325	120	205	826	616	205	95	23	293	210	823
29	Kacherpada	428	1776	887	889	15	0	1318	703	615	458	184	274	751	551	127	70	18	336	200	1025
30	Talbandkhar	78	337	174	163	0	7	254	144	110	83	30	53	159	121	44	2	3	72	38	178
31	Pirkone	719	3015	1486	1529	37	2	2202	1192	1010	813	294	519	1287	704	152	43	29	480	583	1728
32	Sangpalekhar	17	70	34	36	0	0	50	25	25	20	9	11	19	19	4	0	0	15	0	51
33	Govthane	459	2003	999	1004	0	0	1449	782	667	554	217	337	817	522	72	45	4	401	295	1186
34	Pale	254	1052	515	537	0	3	749	411	338	303	104	199	389	169	14	0	5	150	220	663
35	Sarde	338	1389	715	674	0	32	1020	568	452	369	147	222	676	637	265	74	14	284	39	713
36	Kegaon (CT)	1840	7485	4084	3401	646	85	6254	3504	2750	1231	580	651	2810	2342	7	19	14	2302	468	4675
37	Navghar (CT)	1625	6603	3468	3135	596	272	5292	2921	2371	1311	547	764	2514	2011	4	13	16	1978	503	4089
38	Chanje (CT)	3864	16714	8723	7991	770	1162	12033	6756	5277	4681	1967	2714	6586	4820	43	158	240	4379	1766	10128
39	Jasai (CT)	2133	8234	4520	3714	818	214	5587	3315	2272	2647	1205	1442	3220	2982	17	49	113	2803	238	5014
40	Koprol	227	1026	571	455	65	93	756	444	312	270	127	143	387	347	24	16	7	300	40	639
41	Ambivali	92	398	219	179	0	0	265	154	111	133	65	68	133	133	87	1	5	40	0	265
42	Kolgaon	224	877	424	453	0	6	663	347	316	214	77	137	476	303	65	88	15	135	173	401
43	Mandava Tarf Zirad	82	446	235	211	0	266	338	187	151	108	48	60	285	39	2	0	2	35	246	161
44	Koprol	86	333	168	165	0	61	266	142	124	67	26	41	154	120	33	14	0	73	34	179
45	Ranjankhar Davali	333	1339	663	676	0	0	1006	554	452	333	109	224	723	387	23	212	2	150	336	616
46	Rewas	217	1040	528	512	0	912	691	401	290	349	127	222	424	266	8	1	3	254	158	616
47	Belpada	126	520	268	252	0	0	404	234	170	116	34	82	278	23	0	0	0	23	255	242
48	Dhokawade	709	3019	1570	1449	11	234	2441	1343	1098	578	227	351	1516	1113	277	217	84	535	403	1503
Total of study area		25245	105444	55037	50407	4571	5490	79743	44265	35478	25701	10772	14929	41371	32339	2384	1548	1156	27251	9032	64073

Source :Census 2011

3.12.2 Socio-economic analysis based on sample survey

3.12.2.1 Sampling Design

The study area is divided into four strata. The sample of city wards from each stratum as well as the respondent/house-holds within each sampled ward has been selected by two stage stratified random sampling. On the first stage; villages from each stratum are selected and on the second stage; households/ respondents are selected from sampled ward by simple random sampling. From each selected ward, at least two respondents are selected randomly to account intra-ward variability among the respondents.

A sample of 60 respondents was surveyed and the sample covered 254 persons.

3.12.2.2 Composition of the questionnaire

Households/respondents were interviewed with the structured questionnaire specifically designed for this study keeping in view the objectives of the study. The questionnaire consists of following major sections:

- Composition and size of family
- Educational status
- Homestead
- Information on agricultural situation (holding size, land use, cropping pattern, productivity, net return etc.)
- Employment (sources of employment)
- Income (income from various sources)
- Information on family budget
- Consumption and saving
- Respondents' perception about the project

Survey Results: Sources of Income

The study area is an urban area and that too with a number of industries and other businesses. Agriculture is confined to only a small area at the eastern fringes of the study area. **Table 3.31** presents the occupational pattern among the surveyed respondents.

Table 3.31: Sources of Income

Sl. No.	Level of Livelihood	No of persons
1.	Wage Labour	14 (9.86)
2.	Business	33 (23.24)
3.	Service	54 (38.03)
4.	Contractorship	19 (13.38)
5.	Self-employed	17 (11.97)
6.	Retired	5 (3.52)
Total		142 (100)
Figures in () indicate % in total number of persons		

Survey Results: Pattern of demand

The survey reveals that the respondents spend major portion of their disposable income on food items. However, people are quite exposed to consumer society and there has been a growing tendency among the respondents, of higher and higher expenditure allocation on non-food items than before.

Survey Results: Consumption Behaviour

Table 3.32 presents the source wise distribution of average family consumption. It is observed that the major portion of consumption (41.1%) goes to meet the need for food items. This is followed by educational expenses (21.9%), clothing (13.4%). Average expenditure on education is found to be quite high compared many other Indian states (21.9%).

Table 3.32: Source-Wise Distribution of Family Consumption

	Food	Education	Clothing	Medical	Others	Total
Average family consumption (%)	41.1	21.9	13.4	11.7	11.9	100

Survey Results: Educational status

The existing educational status of members of the households is depicted in **Table 3.33**. About 14.2% and 20.2% of the members have education at middle school level and high school level respectively. Some of these people are continuing their education at the next higher level. ~18.9% of the respondents have studied up to +2 level. About 11.2% of the respondents were graduates or diploma holders. 4.3% of the respondents were post- graduates. As reported by the respondents, their interest towards education has been increasing due to hope of getting jobs especially in the industries and businesses which are either operating or are expected to come up in industrial areas in the region.

Table 3.33: Educational Status

Sl. No.	Level of education	No of persons
1.	Illiterate*	7 (3.00)
2.	Primary	19 (8.15)
3.	Middle schooling	33 (14.16)
4.	High schooling	47 (20.17)
5.	Intermediate	44 (18.88)
6.	I.T.I.	47 (20.17)
7.	Graduation / Diploma	26 (7.73)
8.	Post Graduate	10 (4.29)
	Total	233 (100)

Figures in () indicate % in total number of persons.

*Does not include children too young to go to school

CHAPTER – 4

**ANTICIPATED ENVIRONMENTAL IMPACTS
&
MITIGATION MEASURES**

4.0 IMPACT ASSESSMENT

In this chapter the likely impacts during construction and operation phases are identified. Further, the impacts are assessed and evaluated considering spatial, intensity, temporal and vulnerability scales. An overall assessment in terms of significance value is derived by integrating all scales. Detailed methodology is given in subsequent sections.

4.1 METHODOLOGY

The methodology adopted for assessing the potential positive and negative environmental impacts from the proposed project is described below.

Step 1: Identification of Environmental Impacts

All potential releases (emissions to air, generation of noise, effluent discharge, etc.) from the construction & operation phases of the proposed project have been identified. The potential positive and negative environmental impacts from these releases and other activities of the project have been identified.

Step 2: Environmental Impact Assessment

The **Significance (S)** of the Environmental Impacts is identified and assessed by the following characteristics:

- **Intensity (I)** of the environmental impact;
- **Spatial extension (Sp)** of the environmental impact;
- **Temporal duration (T)** of the environmental impact;&
- **Environmental Vulnerability (V)** of the impacted area.

Determination of Impact Intensity (I):

Impact Intensity has been assessed based on the following criteria:

H (High):

- Emissions/generation of highly pollutant substances, emissions/generation of high quantity of pollutant substances and/or high noise emission.
- High consumption of resources (such as energy, water, land, fuel, chemicals)
- Felling of large number of trees or death of fauna

M (Medium):

- Emissions/generation of moderately pollutant substances, emissions/generation of moderate quantity of pollutant substances and/or moderately high noise emission.
- Moderate consumption of resources (such as energy, water, land, fuel, chemicals)
- Felling of few trees or physical damage of fauna

L (Low):

- Emissions/generation of low pollutant substances, emissions/generation of low quantity of pollutant substances and/or low noise emission
- Low consumption of resources (such as energy, water, land, fuel, chemicals)
- Damage to few trees or disturbance/ disorientation of fauna

N (Negligible):

- Emissions/generation of very low pollutant substances, emissions/generation of very low quantity of pollutant substances and/or very low noise emission.
- Very low consumption of resources (such as energy, water, land, fuel, chemicals)
- No measurable damage to flora/fauna

Determination of Impact Spatial extension (Sp) and Spatial Criteria (Is):

Impact Spatial extension has been assessed based on the following criteria:

- **H (High):** the impact extends in a wide area outside the site (about 10 km or more)
- **M (Medium):** the impact extends in a restricted area outside the site (< 10 km)
- **L (Low):** the impact extends inside the site.
- **N (Negligible):** the impact extends in a restricted area inside the site.

The product of Impact Intensity and Impact Spatial extension gives the impact evaluation as per **spatial criteria (Is)**.

Table 4.1: Matrix for Evaluating Spatial criteria

Impact evaluation as per SPATIAL CRITERIA (Is)		Impact Spatial extension (Sp)			
		HIGH	MEDIUM	LOW	NEGLIGIBLE
Impact Intensity (I)	HIGH	H	H	H	H
	MEDIUM	H	M	M	M
	LOW	M	L	L	L
	NEGLIGIBLE	N	N	N	N

Determination of Impact Temporal duration (T) and Temporal Criteria (It)

Impact Temporal Duration has been assessed based on the following criteria:

- **H (Very High):** the impact has an important long-term effect (> 5 years)
- **H (High):** the impact has an important long-term effect (1-5 years)
- **M (Medium):** the impact has a medium-term effect (1 week – 1 year)
- **L (Low):** the impact has a temporary and short-term effect (1 day – 1 week)
- **N (Negligible):** the impact has an immediate effect and it is solved in a very short time.

The product of Impact Temporal duration and Spatial criteria gives the **Impact Evaluations** as per Temporal Criteria (It).

Table 4.2: Matrix for Evaluating Temporal criteria

Impact evaluation as per TEMPORAL CRITERIA (It)		Impact Temporal duration (T)				
		VERY HIGH	HIGH	MEDIUM	LOW	NEGLECTIBLE
Impact Is	HIGH	H	H	H	H	H
	MEDIUM	H	M	M	M	L
	LOW	M	M	L	L	L
	NEGLECTIBLE	N	N	N	N	N

Determination of Environmental Vulnerability (V) and Significance (S)

Environmental Vulnerability has been assessed based on the following criteria:

- **H (High):** Particular interesting area from the environmental, historical, social point of view. Parks, natural reserves and / or special areas of conservation. Contaminated areas in which a further impact may generate non-compliance with local environmental limits.
- **M (Medium):** Interesting area from the environmental, historical, social point of views. Residential areas with low population density. Agricultural areas, forests, public parks.
- **L (Low):** Industrial and commercial areas.

The product of Vulnerability and Temporal criteria gives the **Significance** of the impact.

Table 4.3: Matrix for Evaluating Significance

Impact evaluation as per VULNERABILITY CRITERIA (SIGNIFICANCE S)		VULNERABILITY (V)		
		HIGH	MEDIUM	LOW
Impact It	HIGH	H	H	M
	MEDIUM	H	M	M
	LOW	M	M	L
	NEGLECTIBLE	L	N	N

The **Impact Significance (S)** levels obtained from the above-matrix are defined as follows:

- **H (High):** Causes severe and acute effects to receptors, severe and irreversible deterioration of the quality of environment, and irreversible modification of landscape or of ecological equilibrium.

- **M (Medium):** Causes moderate effects to receptors, reversible deterioration of the quality of environment, and reversible modifications of landscape or ecological equilibrium.
- **L (Low):** Causes limited effects to receptors, quickly reversible deterioration of the quality of environment, and slight and reversible modification of landscape or ecological equilibrium.
- **N (Negligible):** Causes negligible or no effects to receptors, slight and reversible deterioration of quality of the environment, no measurable changes at landscape or ecological level.

The assessment has been carried out for each of the potential environmental impacts during both construction and operation, and has been discussed in this chapter.

4.2 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

The environmental impacts associated with the proposed project on various environmental components such as air, water, noise, soil, flora, fauna, land, socioeconomic, etc. has been identified using Impact Identification Matrix (**Table 4.4**).

Table 4.4: Impact Identification Matrix

Activities	Physical				Biological		Socio-economic	
	Ambient air quality	Ground / surface water (quantity / quality)	Ambient noise	Land (land use, topography & drainage, soil)	Flora	Fauna	Livelihood & occupation	Infrastructure
CONSTRUCTION PHASE								
Site preparation	*		*	*	*	*	*	
Civil works	*		*			*		
Heavy equipment operations			*					
Disposal of construction wastes				*				
Generation/disposal of sewerage		*		*				
Transportation of materials	*		*					
OPERATION PHASE								
Commissioning of Process units, utilities and offsite	*	*	*					
Product handling and storage	*							
Emissions & Waste management – Air, liquid and solid waste	*	*		*				

4.3 AIR ENVIRONMENT

4.3.1 CONSTRUCTION PHASE

Construction activities are anticipated to take place over a period of at least two years from Zero date of Construction. Following mechanical completion, Commissioning and production ramp-up leading to 100% capacity utilization will be achieved in six months.

Potential emissions sources during construction phase include the following:

- Site preparation and civil works
- Storage and handling of construction material (e.g. sand, cement) at proposed project site.
- Movement of vehicles carrying equipment, construction material and project-related personnel

The impacts are described below:

- Dust will be generated from earth-moving, grading and civil works, and movement of vehicles on unpaved roads.
- PM, CO, NO_x, & SO₂ will be generated from operation of diesel sets and diesel engines of machineries and vehicles.

The significance of the impacts of air emissions on ambient air quality during construction phase is summarized in **Table 4.5**.

Table 4.5: Impact of air emissions (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Overall quantity of air emission will be of less quantity over a day and Low consumption of power from DG sets.
Spatial	Low	Impact extends inside the proposed site
Temporal	High	Long term effect as the construction period spans up to 2 years
Vulnerability	Low	Proposed project is located within ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors as per methodology given in Section 4.1
Impact(I _t)	Low	By combining I _s and temporal factors as per methodology given in Section 4.1
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors as per methodology given in Section 4.1

Mitigation Measures

- Ensuring preventive maintenance of vehicles and equipment.
- Ensuring vehicles with valid Pollution under Control certificates are used.
- Avoiding unnecessary engine operations.
- Implementing dust control activities such as water sprinkling on unpaved sites.
- Controlled vehicle speed on site
- Ensuring vehicle are covered during transportation of material

4.3.2 OPERATION PHASE

EMISSIONS FROM COMBUSTION SOURCES

INDUSTRIAL SOURCE COMPLEX SHORT TERM - 3 (ISCST3) MODEL

The model used in the present study is Industrial Source Complex Version 3, which is a AERMOD Dispersion Modelling Program designed to estimate pollutant concentrations for simple, intermediate, or complex terrain. The Industrial Source Complex Short Term or in brief ISCST model is one of the United States Environmental Protection Agency (USEPA)'s UNAMAP series of air quality models.

The Industrial Source Complex (ISC3) models are used to predict pollutant concentration from continuous point, area and volume sources. These versatile models are preferred by the USEPA because of many features that enable the user to estimate the concentrations nearly any type of source emitting non-reactive source.

The ISC short-term model for stack uses Steady State Gaussian plume equation for the continuous elevated source. For the cross wind and downwind distances, the model uses either polar or rectangular Cartesian co-ordinates as specified by the user. For wind speed profile, wind power law is used to adjust the observed wind speed to the stack or release height. For computation of plume rise, Briggs plume rise formula is used. The distance dependent momentum plume rise equations are used to determine if the wake region for the building downwash calculations affects the plume. In order to consider the stack tip downwash, modification in stack height is performed using Briggs (1974). The point source dispersion parameters are computed using the Turners (1970) equation that approximately fits the Pasquill-Gifford curves. In order to take in account for the wake effect, plume dispersion theory of Huber (1976) and Snyder (1977) has been used. The buoyancy-induced dispersion has been taken care off using Pasquill method. The vertical term and dry depositions are also taken into account by this model.

Besides the above, for a given land use category (e.g., Auer Land use category), the model can be used for either Urban or Rural dispersion coefficient. The model also calculates the downwash from the nearby building and the fumigation conditions. The terrain variation is also included in form of flat, simple, intermediate and complex terrain. The input requirements for the ISC model short-term computer program consist of four categories of information:

- Hourly meteorological data
- Source data
- Receptor data
- Program control parameters

Meteorological inputs required by the program include hourly estimates of the wind direction, wind speed, ambient air temperature, mixing height, wind profile exponent and vertical temperature gradient. Some of the data required as mentioned above e.g., vertical temperature gradient, wind profile exponent and mixing depths call for a detailed study in itself, which in this case was not possible. Therefore, USEPA approved default values of wind exponents and temperature gradient as available in ISC3 have been used.

In the present study, the micro-meteorological data i.e., wind speed, wind direction, relative humidity and ambient temperature was collected by M/s J.P. Test and Research Center for the period of January-March 2018 was used. The source data i.e. continuous stack emissions from different process units have been furnished by process licensor.

The input data requirements for each source include data specific to the source and its type (whether point, area or volume source). The source-input requirements for running the program are the emission height, location, exit velocity, exit temperature and strength. The receptor data can be given either as polar, rectangular Cartesian or discrete ones. The program control includes options regarding pollutant type, dispersion options, averaging time, flag pole receptor and exponential decay etc.

4.3.2.1 Impacts due to releases of SO₂ and NO_x

For the proposed project the emission sources are GT-IV stack and ERT0 stack. The fuel for GT-IV will be primarily fuelled by "Fuel Gas" available in-house as described in Chapter-2. Due to sweetening of Natural Gas, acid gas which contains H₂S needs to be treated. Hence, ERT0 is envisaged to treat this H₂S. Though there will be small quantity of SO₂ emission from ERT0, overall H₂S emission to atmosphere shall be greatly reduced. The status of SO₂ and NO_x releases from the proposed project are depicted below in Tables 4.6.

Table 4.6: Emission summary

Stack details	Stack Characteristic				SO ₂ Emission (g/s)	NO _x Emission (g/s)
	Height (m)	Dia (m)	Temp (K)	Gas Flow (Nm ³ /hr)		
GT-IV stack	40	3.0	408.4	391500	0.28	5.14
ERT0 Stack	50	1.17	341	25170	1.18	-

SO₂ CONCENTRATION

The isopleths for 24 hourly maximum average is shown in Figure 4.1 and the results are tabulated in Table 4.7.

From the table 4.7, the SO₂ GLC (maximum 24 hr Ground Level Concentration) due to operation of proposed is predicted as 1.44 µg/m³. This GLC is occurring 100 m outside plant boundary wall in south east direction.

Maximum 98 Percentile Baseline Value (within 10 km radius) is 9.4 µg/m³. By superimposing the same with background SO₂ level, the maximum resultant GLC observed are 10.84 µg/m³ (24 hourly averages) which is well within the standard limits for 24 hourly averages for industrial area i.e. 80 µg/m³.

Table 4.7 Predicted values of GLC for SO₂

	SO ₂ (24 hourly maximum)				
	Maximum GLC µg/m ³	Maximum GLC From Centre of Plant (0,0) Co-ordinates (m)	Location from the plant Centre (m)	Maximum 98 th Percentile Baseline Value (within 10 km radius) µg/m ³	Resultant 98 th Percentile Value µg/m ³
Release of emission sources	1.44	1000, -500	Outside boundary wall (In S-E direction and at ~100 m from boundary)	9.4	10.84

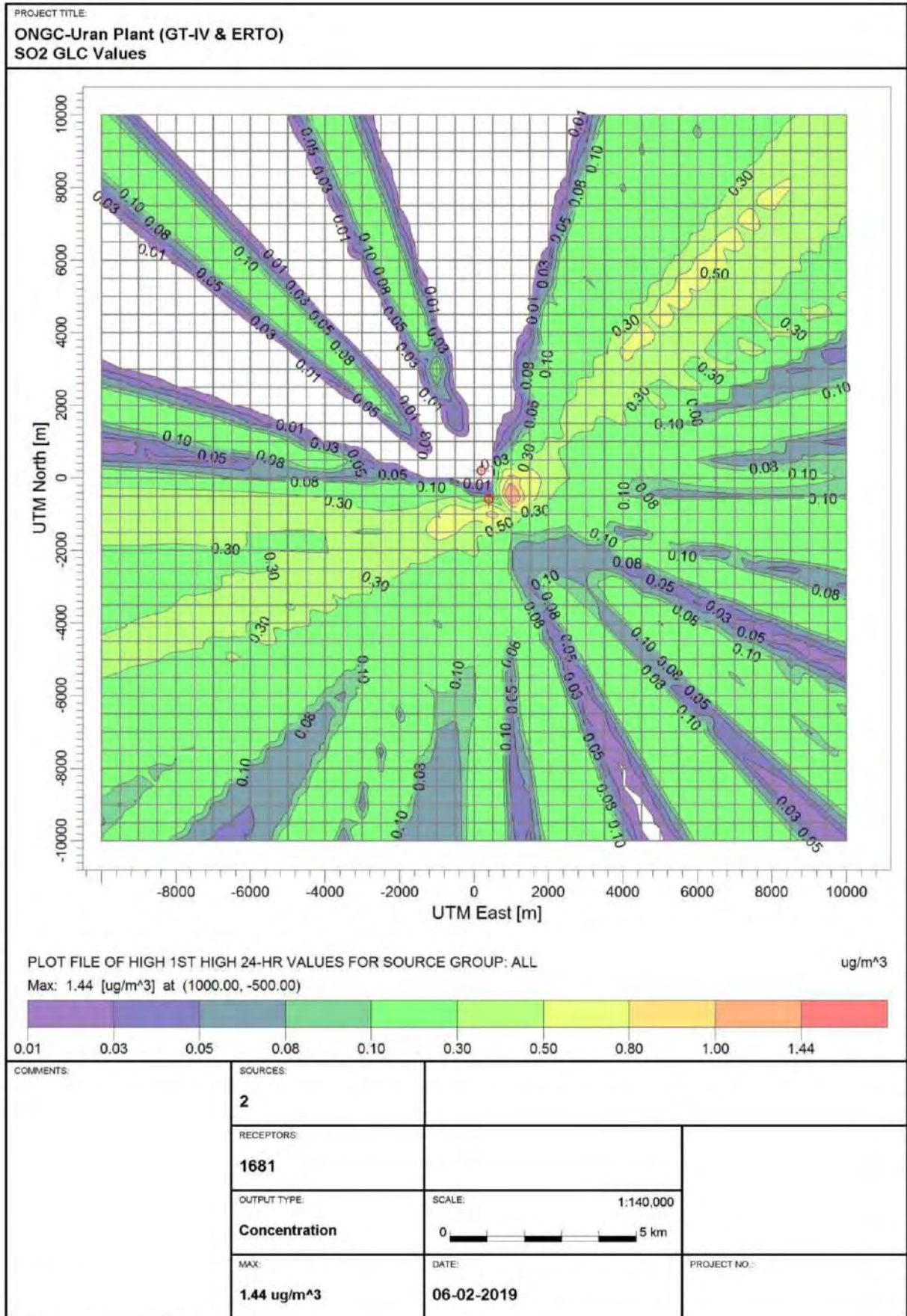


Fig.4.1 Isopleths for GLC- 24 hourly SO₂ for proposed project

NO_x Concentration

The isopleths for 24 hourly maximum average for NO_x is shown in Figure 4.2 and the results are tabulated in Table 4.8. From the table 4.8, the NO_x GLC (maximum 24 hr GLC) due to operation of proposed facilities is predicted as 1.52 µg/m³. This GLC is occurring 500 m outside plant boundary in North East direction.

Maximum 98 Percentile Baseline Value (within 10 km radius) is 33.5 µg/m³. By superimposing the same with background NO_x level, the maximum resultant GLC observed is 53.84 µg/m³ (24 hourly averages) which is well within the standard limits for 24 hourly averages for industrial area i.e. 80 µg/m³.

Table 4.8: Predicted values of GLC for NO_x

	NO _x (24 hourly maximum)				
	Maximum GLC µg/m ³	Maximum GLC From Centre of Plant (0,0) Co-ordinates (m)	Location from the plant Centre (m)	Maximum 98 th Percentile Baseline Value (within 10 km radius) µg/m ³	Resultant 98 th Percentile Value µg/m ³
Release of emission sources	1.52	1000, -500	Outside boundary wall (In N-E direction and at ~500 m from boundary)	33.5	35.02

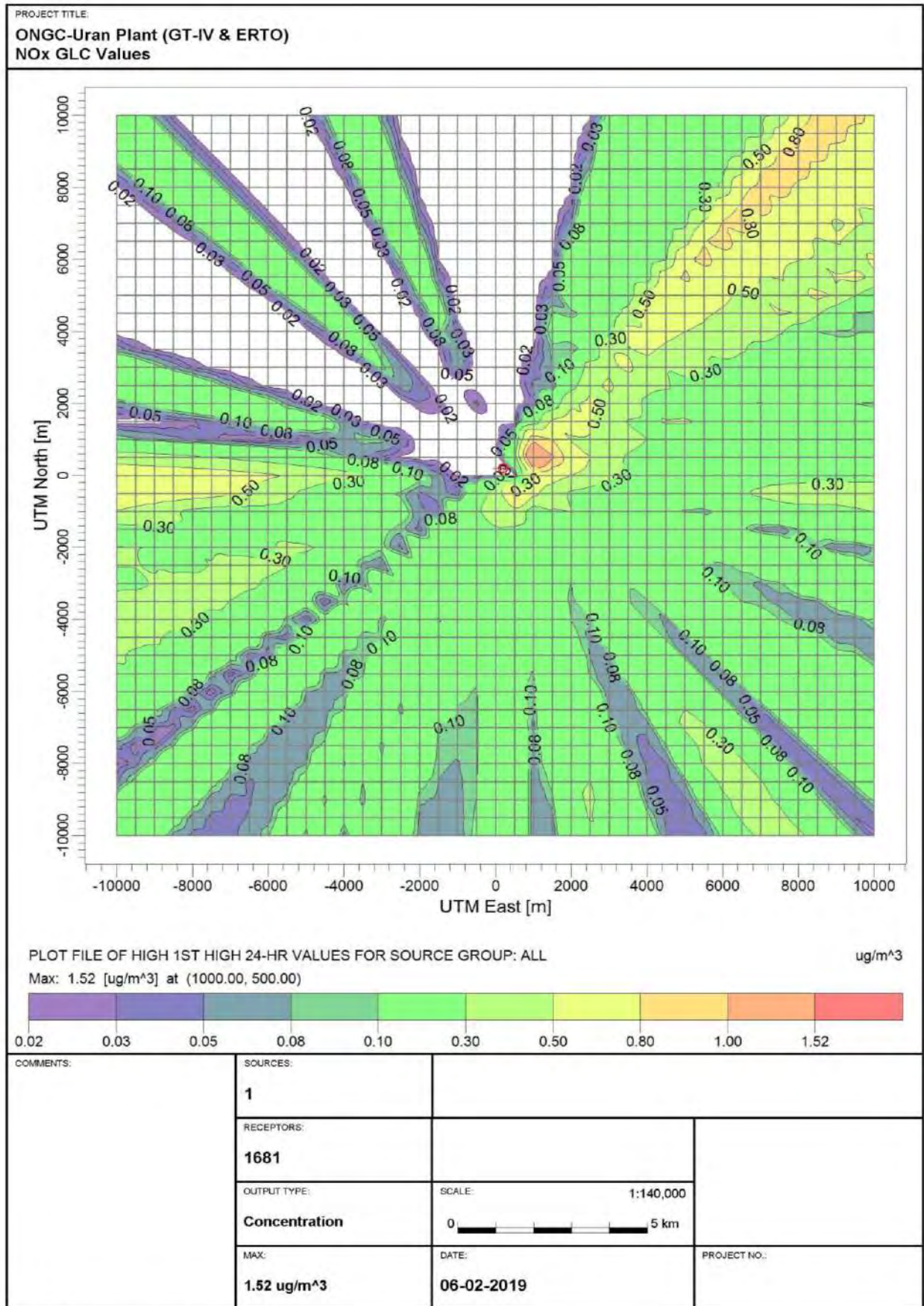


Fig.4.2 Isoleths for GLC- 24 hourly NOx for proposed project

Summary of Impacts

- The resultant SO₂ with ambient air quality concentration is estimated as 10.84 µg/m³ which is well within the standard limits for 24 hourly average for industrial area i.e. 80 µg/m³.
- The resultant NO_x ambient air quality concentration is estimated as 35.02 µg/m³ which is less than which is well within the standard limits for 24 hourly average for industrial area i.e. 80 µg/m³.

The significance of the impacts of air emissions on ambient air quality during operation phase is summarized in **Table 4.9**.

Table 4.9: Impact of air emissions (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Marginal additional emissions due to combustion.
Spatial	Low	Resultant concentration occurring close to the plant boundary
Temporal	Low	The addition of pollutants will over a day, but continuous
Vulnerability	Low	Proposed project is located inside existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors as per methodology given in Section 4.1
Impact(I _t)	Low	By combining I _s and temporal factors as per methodology given in Section 4.1
Overall Significance Value of Impact(S)	Low	By combining I _t and Vulnerability factors as per methodology given in Section 4.1

Mitigation measures

- Ensuring preventive maintenance of equipment.
- Regular monitoring of air polluting concentrations.

4.4 WATER ENVIRONMENT

4.4.1 CONSTRUCTION PHASE

During construction phase, raw water will be required for the following purposes:

- Civil works (such as concrete mix preparation, curing etc)
- Hydro testing (of tanks and associated piping)
- Domestic use (such as drinking water for workers, washing etc.)
- Water sprinkling on site for dust abatement

Raw water for construction phase will be met from existing water source i.e. by Maharashtra Industrial Development Corporation (MIDC). The peak water requirement during construction will be upto 50 KLD. The significance of the impact of raw water consumption on local water resources during construction phase is summarized in **Table 4.10**.

Table 4.10: Impact of water consumption (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Water requirement will be limited to 50 KLD in a day.
Spatial	Low	Requirement is limited to a proposed site works only.
Temporal	Low	The impact has a temporary and short term effect i.e. only during construction period
Vulnerability	Low	Proposed project is located inside existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact(S)	Low	By combining I _t and Vulnerability factors

The effluent streams that will be generated regularly during construction stage include the following:

- Sewage and grey water from work sites
- Cleaning and washing water for vehicle and equipment maintenance area.

During construction, waste materials would contribute to certain amount of water pollution. But these would be for a short duration. All liquid waste will be collected and disposed to identify water impoundment within the construction site. Later at frequent intervals the same shall be disposed through tankers using gully suckers to common waste treatment facility. The significance of the impact of waste water generation during construction phase is summarized in **Table 4.11**.

Table 4.11: Impact of effluent generation (construction phase)

Factors of Assessment	Value of assessment	Justification
Intensity	Low	Releases of low quantity
Spatial	Low	Requirement is limited to a proposed site works only.
Temporal	Low	Restricted to construction period
Vulnerability	Low	Proposed project is located in existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact(S)	Low	By combining I _t and Vulnerability factors

Mitigation Measures

- Monitoring water usage at work sites to prevent wastage.

4.4.2 OPERATION PHASE

The new GT-IV will not require any additional water. The existing Thermax Boiler will be scrapped. The water being utilised by this boiler, will now be consumed by the proposed unit. For ERT0 unit additional ~220 m³/day of raw water is required which will be met from existing sources (MIDC). However, the raw water demand of the complex shall be well within the consent limit of 16500 m³/day.

The impact on water environment during the operation phase of the proposed changes shall be in terms of water consumption and waste water generation due to process activities.

The impact of water consumption on local resources during operation phase is summarized in **Table 4.12**.

Table 4.12: Impact of water consumption (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Water required is limited to 220 m ³ /day
Spatial	Low	Water will be used for proposed project within existing ONGC-Uran complex only. No additional water from MIDC.
Temporal	High	Requirement of water will be continuous.
Vulnerability	Low	Designated Industrial area
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Medium	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Medium	By combining I _t and Vulnerability factors

The liquid effluent (quantity <100 m³ per day), mainly brine solution of Sodium Sulfite (Na₂SO₃) shall be generated from new ERT0 unit. The effluent shall be diluted with existing treated water (~ 3000m³ per day) from effluent treatment plant and finally discharged into sea (complying MPCB standards). Sodium Sulfite (Na₂SO₃) being white colored salt solution and all parameters like BOD, COD, TDS, TSS, PH shall be maintained as per MPCB norms, before discharging to sea, hence there shall be no adverse impact on Sea water. Other non process wastewater streams like blow-down of boiler and cooling tower will be treated in existing facilities. The impact of effluent generation during operation phase is summarized in **Table 4.13**.

Table 4.13: Impact of effluent generation (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Release of 100 m ³ day (max.) liquid Effluent which shall be mixed with present ETP treated water meeting MPCB standard.
Spatial	Low	Treated effluent will be disposed off to sea after meeting required standard.
Temporal	Low	Liquid effluent shall meet all required standard before disposal.
Vulnerability	Low	Treated effluent will have some additional salt

		(Sodium Sulfite (Na ₂ SO ₃)) content only.
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors

Mitigation Measures

- Additional effluent shall be mixed with treated ETP effluent before discharge to sea. Monitoring of water quality at regular intervals.

4.5 NOISE ENVIRONMENT

4.5.1 CONSTRUCTION PHASE

During construction phase, civil works such as trenching, foundation casting, steel work, infrastructure construction, mechanical works such as static equipment and rotating machinery installation, building up of piping network, provision of piping supports, and tying up of new facilities with the existing systems etc. are likely to affect the ambient noise level. Also, the movement of heavy motor vehicles carrying construction material, pipes and equipment, loading and unloading activities, and movement of light passenger vehicles conveying construction personnel are likely to affect the ambient noise level, However, these effects are for a short term and of temporary in nature.

Construction noise levels associated with typical machinery based on “BS 5228: 1997 Noise and Vibration Control on Construction and Operation Sites” are summarized in the **Table 4.14**.

Table 4.14: Sound Pressure (noise) levels of Construction Machinery

Item Description	Noise Level dB(A)	Reference Distance
Earth Movers		
Front Loaders	72-84	0.9 m
Backhoes	72-93	"
Tractors	72-96	"
Scrapers, Graders	80-93	"
Pavers	86-88	"
Trucks	82-94	"
Material Handlers		
Concrete Mixers	75-88	0.9 m
Concrete Pumps	81-83	"
Cranes (movable)	75-86	"
Cranes (derrick)	86-88	"
Item Description	Noise Level dB(A)	Reference Distance
Stationary Equipment		
Pumps	69-71	0.9 m
Generators	71-82	"
Compressors	74-86	"

The impact of noise emissions on ambient noise levels are summarized in **Table 4.15**.

Table 4.15: Impact on Ambient Noise (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	All equipment will be purchased that conforms to standard limits for noise.
Spatial	Low	Impact extends inside site
Temporal	Low	Noise emission is not continuous, occurs only any machinery or DG is operated
Vulnerability	Low	Proposed project site is within existing ONGC-Uran complex.
Evaluation of factors		
Impact(I_s)	Low	By combining intensity and spatial factors
Impact(I_t)	Low	By combining I_s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I_t and Vulnerability factors

Mitigation Measures

- Ensuring preventive maintenance of equipments and vehicles.
- Avoiding unnecessary engine operations (e.g. equipments with intermitted use switched off when not working).
- Ensuring DG sets are provided with acoustic enclosures and exhaust mufflers.

4.5.2 OPERATION PHASE

During operational phase of the proposed project, the noise shall be caused due to various rotating equipment viz. Pumps, Compressors & Mixers, etc. The **Table 4.14** gives the listing of various noise generating sources along with their design noise level considered. The impact of these noise emissions during operation is summarized in **Table 4.16**.

Table 4.16: Impact on ambient noise (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Release of low quantity as all the noise generating equipments will be provided with enclosures / noise absorbing materials as per present practice.
Spatial	Low	The impact extends inside the site.
Temporal	Low	Some of the Noise emissions will be intermittent and others continuous.
Vulnerability	Low	Proposed project is located within ONGC-Uran complex.
Evaluation of factors		
Impact(I_s)	Low	By combining intensity and spatial factors
Impact(I_t)	Low	By combining I_s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I_t and Vulnerability factors

Mitigation Measures

- Avoiding continuous (more than 8 hrs) exposure of workers to high noise areas.
- Provision of ear muffs at the high noise areas
- Ensuring preventive maintenance of equipment.

4.6 LAND ENVIRONMENT

The proposed project will be coming within existing ONGC-Uran complex in and henceforth there will be no major change in land use / land cover of the surrounding area.

4.6.1 CONSTRUCTION PHASE

The impact on land environment during construction phase shall be due to generation of debris/construction material, which shall be properly collected and disposed off.

During construction, there will be no routine discharge or activity potentially impacting soils and groundwater.

The impact on land use and topography during construction phase is summarized in **Table 4.17**.

Table 4.17: Impact on Land Use & Topography (Construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Solid waste generated during the construction period shall be of low quantity as the scrapes and reusable materials are sold out and other waste are disposed off suitably.
Spatial	Low	The impact extends inside the site.
Temporal	Low	The impact will be limited to 24 months.
Vulnerability	Low	Proposed project is located in existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors

There is potential for impact on soil quality due to project-related spills and leaks of fuel and chemicals and uncontrolled disposal of wastes and wastewater. Care will be taken to avoid spills and leaks of hazardous substances and all project-related wastes. Littering of sites and areas beyond the site will be controlled.

The impact on soil quality during construction phase is summarized in **Table 4.18**.

Table 4.18: Impact on soil quality (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Releases of low quantity
Spatial	Low	The impact extends inside the site.

Temporal	Low	The impact will be limited to 24 months.
Vulnerability	Low	Proposed project is located in existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors

Mitigation Measures

- Restricting all construction activities inside the project boundary.
- Ensuring the top soil is not contaminated with any type of spills.
- Ensuring any material resulting from clearing and grading should not be deposited on approach roads, streams or ditches, which may hinder the passage and/or natural water drainage.
- Developing project specific waste management plan and hazardous material handling plan for the construction phase.

4.6.2 OPERATION PHASE

There shall be no hazardous solid waste generation from GT-IV and ERTO. Only filter cartridges (having life of around one year) is disposable which shall be disposed as per relevant rules through Mumbai Waste Management Limited (MWML). The solid wastes generated during the course of regular operation of the existing plant are given in Table 4.19.

Table 4.19: Solid Waste Generation at ONGC's Uran Plant

Description	Generation (tonnes)	
	During 2013 - 14	During 2014 - 15
Filter candles.	4.14	6.225
Glass wool	134.61	37.01
Poly-Urethane Foam	4.140	2.085
Spent catalysts & molecular sieves	21.465	0
Spent charcoal	10.060	8.75
Sludge from storage tanks	512.52	218.785
Electrical wastes	0.60	0
Polypropylene bio-tower packing media		
Spent resin		
Batteries (Lead-acid / Nickel-cadmium)		

ONGC has standardized the useful life of all equipment at the plant. All equipment are replaced at the end of their life. ONGC Ltd. has entered into an agreement with M/s Mumbai Waste Management Ltd., who are operating a Common Hazardous Waste Treatment, Storage and Disposal Facility (TSDF) at Taloja in Raigad District of Maharashtra at an aerial distance of ~28 km north-east of ONGC's Uran plant.

The TSDF has an incinerator and secured land-fill along with other necessary infrastructure for treatment of and disposal of industrial wastes. The wastes are segregated at the plant itself and stored in a dedicated waste storage facility at the plant. The wastes are transported by the TSDF's dedicated trucks with proper documentation from Uran to the TSDF site.

Decommissioned equipment are disposed off as scrap by the Materials Management Department. Waste oil and lubricants are sold off to authorized recyclers. Unsold used oil is disposed off to the TSDF.

Kitchen waste, generated at the plant's canteens is presently being disposed off through local municipal authorities. Converting kitchen waste to compost is in process

The impacts on soil quality during operation phase are summarized in **Table 4.20**.

Table 4.20: Impact on soil quality (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Releases of low quantity (~nil)
Spatial	Low	No solid waste generation is envisaged.
Temporal	Low	No impact on soil.
Vulnerability	Low	Proposed project is located within existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors

Mitigation Measures

- No impact on soil environment..

4.7 BIOLOGICAL ENVIRONMENT

4.7.1 Construction phase

Impact Evaluation

The proposed facilities are to be developed within existing ONGC-Uran Complex. The proposed area for GT-IV and ERT0 has been shown in Fig. 2.2 in Chapter-2. The project site does not harbor any fauna of importance. Therefore, the impact of construction activities on fauna will be insignificant. The impacts on flora and fauna during construction phase are summarized in **Table 4.21**.

Table 4.21: Impact on Biological Environment (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	No major clearing of vegetation will be carried out
Spatial	Low	Activity is limited to proposed project site.
Temporal	Low	Activity is limited to 24 months.
Vulnerability	Low	Project site is located in existing ONGC-Uran Complex
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value	Low	By combining I _t and Vulnerability factors

of Impact (S)		
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Mitigation Measures:

- Closing of trenches as soon as possible of construction.
- Prevent littering of work sites with wastes, especially plastic and hazardous waste.
- Training of drivers to maintain speed limits.

4.7.2 Operation phase

Impact Evaluation

The impacts due to proposed project activities during operation phase shall be limited. Impacts on Flora & Fauna during operation phase are summarized in **Table 4.22**.

Table 4.22: Impact on Biological Environment (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	No additional significant emissions
Spatial	Low	Site does not harbor any flora & fauna.
Temporal	Low	No additional emissions
Vulnerability	Low	Industrial area
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors

Mitigation measures

- Develop the greenbelt already developed
- Plant additional trees during operation phase as per greenbelt development plan

4.8 SOCIO ECONOMIC ENVIRONMENT

4.8.1 CONSTRUCTION PHASE

The issues need to be addressed during the construction phase of the project include the effect of employment generation and additional transport requirements on local infrastructural facilities. These are only short term impacts lasting during the construction phase of the project.

4.8.1.1 Employment Generation

The construction phase is expected to span for two years. During this phase, the major socio-economic impact will be in the sphere of generation of temporary employment of very substantial number of personnel. Based upon the information on the construction of other similar plants, it can be observed that the number of personnel needed for the proposed project during the construction phase, average temporary manpower requirement is 500 people during first year and 1500 people during second year.

4.8.1.2 Effect on Transport

Transport requirements will arise during the construction phase due to the movement of both the personnel and materials. The site is well connected to direct road and rail network.

(a) Transport of Personnel

Transport of the managerial personnel is likely to increase the vehicular traffic on the roads connecting the proposed site to the city. The incremental traffic for the additional people would be about 300 cars.

(b) Transport of construction materials

The transport of construction materials to the project site will result in increased traffic in the impact area. The constructions of capital intensive structures such as reactors and columns require iron and steel, heavy construction equipment and other construction materials. They will have to be transported to the site using trucks. Roughly, on an average of approximately 20 trucks per day will be needed for transporting the construction materials.

(c) Effect on local traffic

The incremental daily traffic during construction phase works out to be about 100 cars and 10 buses per day.

4.8.1.3 Effect on Other Local Infrastructure

The majority of skilled and unskilled labourers are available in the impact area itself, the incremental effect on housing during the construction phase will be minimal. But, during the working hours of the day, the demand for food, water, sanitation and health facilities at the construction site will go up.

Though the truck drivers appear to form a floating population, there will be a general flow of this group throughout the duration of the construction phase. There will be an impact on basic necessities like shelter, food, water, sanitation and medical facilities for the truck drivers. The impact of construction activities on socio-economic environment during construction phase is summarized in **Table 4.23**.

Table 4.23: Impact on Socio-Economic Environment (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Involvement of labour, infrastructure and other utilities in a phased manner. Also it is considered as a positive impact in terms of employment generation
Spatial	Low	Impact extends in a restricted area outside the boundary (< 1 km). Also this is a positive impact in terms of employment generation.
Temporal	Low	The impact has an medium term effect (1 week – 1 year). Also this is a positive impact in terms of employment generation
Vulnerability	Low	Positive impact in terms of employment

		generation
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact(S)	Low	By combining I _t and Vulnerability factors

Mitigation Measures

- Conducting awareness programmes for workers.
- Monitoring speed and route of project-related vehicles
- Determining safe, legal load limits of all bridges and roads that will be used by heavy vehicles and machinery.
- Determining allowable traffic patterns in the affected area throughout the work week will be made based on community use, include a consideration of the large turning requirements of certain vehicles/machineries that might increase congestion and traffic hazards.
- Consolidating deliveries of materials and personnel to project sites, whenever feasible, to minimize flow of traffic.
- Minimizing interruption of access to community for use of public infrastructure
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Preventing use of drugs and alcohol in project-sites
- Preventing possession of firearms by project-personnel, except those responsible for security.

4.8.2 OPERATIONAL PHASE

Operational phase of the plant covers the entire life span of the plant. Hence the impacts of the operational phase extend over a long period of time. These impacts include employment generation, effects on transport and other basic infrastructure.

Employment Scenario

Employment of approximately 200 persons directly and around 1000 persons indirectly (biomass supply chain management) is envisaged during operation phase.

Effect on Transport

Transport requirements will arise (marginal) due to the movement of both the personnel and materials.

(a) Transport of Personnel

There shall be increase in additional load on traffic due to transport of personnel.

(b) Transport due to movement of materials/products

The products will be transported through road.

(c) Effect on local traffic

The incremental traffic during the operational phase works out to be about 800 cars, 1000 two wheelers, light commercial vehicles, buses etc. The impact of these activities on socio-economic environment during operation phase is summarized in **Table 4.24**.

Table 4.24: Impact on Socio-Economic Environment (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Involvement of labour, infrastructure and other utilities in marginal quantities/Nos.
Spatial	Low	Impact extends in a restricted area outside the site
Temporal	Low	The impact has a positive effect
Vulnerability	Low	Positive impact in terms of employment generation
Evaluation of factors		
Impact(I _s)	Low	By combining intensity and spatial factors
Impact(I _t)	Low	By combining I _s and temporal factors
Overall Significance Value of Impact (S)	Low	By combining I _t and Vulnerability factors

Mitigation Measures

- Extending reach of CSR/CER Program
- Monitoring speed and route of project-related vehicles

4.9 OCCUPATIONAL HEALTH & SAFETY

4.9.1 Anticipated Impacts

The work place is divided in terms of activities. The principal occupational risks in the plant are:

- ❖ Fire and explosion during handling and storage of Crude Oil, LPG, Natural Gas, Naphtha, C2-C3
- ❖ Accidents involving leakage / spillage of hazardous / corrosive chemicals (e.g. mercaptans, acids and alkalis used in DA / DM Water Plant) etc.
- ❖ Inhalation of toxic gases / fumes (e.g. H₂S)
- ❖ Accidents involving fall from height
- ❖ Hearing loss
- ❖ Accidents at electrical installations
- ❖ Boiler explosion(at co-generation units)

4.9.2 Management Measures

All workers undergo a Pre-Employment Medical Examination. Some of the tests are carried out at ONGC's hospital at Panvel and the rest at external empanelled hospitals, which have necessary resources for carrying out such tests. The pre-employment medical examinations cover:

- General Physical examination
- Blood pressure
- Blood, urine and stool tests
- Chest X-Ray
- Vision Test
- Hearing test
- Ear, Nose, Throat examination.
- Metabolism test (BMR Index) through dietician
- Gynecological tests for females

As a matter of policy, ONGC employees undergo a Periodical Medical Examination (PME) as follows:

Table 4.25: Frequency of Periodical Examination of ONGC Employees

Type of PME	Coverage	Periodicity
General PME	Employees up to 45 years old	Every 5 Years
	Employees in age group 46 - 55	Every 3 Years
	Employees >56 years old	Every 2 Years
Specific PME	Employees having hazard based profiles	Every 3 months to 2 Years depending on Hazard
Intermediate PME	On need basis. Up to 10% employees undergo PME in a particular year	Every Year

The laboratory tests and other investigations performed during PME are listed in **Table 4.26**.

Table 4.26: Laboratory Tests and Other Investigations to be performed During PME

Tests	Particulars to be
A. Laboratory	
CBC	Hb%, RBC, TLC, DLC, Platelet Count, Parasites, Abnormal cells
Blood Group	Group and Rh factor
ESR	By Wintrobe's Method
VDRL	Rapid
RA Factor	
HIV I /II	Card test after obtaining informed, written consent of the patient
HbsAg	
Blood Sugar	Fasting, with urine sugar
Blood Sugar (PP)	After 2 hours following a normal meal. With urine sugar
Lipid Profile	Sr. Cholesterol, Triglycerides, HDL, LDL, CH / HDL ratio
LFT	Total bilirubin, Sr. alkaline phosphatase, SGOT, SGPT, GGT
RFT	Blood urea, Sr. Creatinine, Sr. Uric Acid
Sr. Calcium	
Sr. Phosphorus	
Urine (Routine)	Including physical and microscopic examination
Stools (Routine)	To detect parasites, bile salts etc.
Sputum	Routine and for AFBs
PAP Smear	For Exfoliative Cervical Cytology
B. Other	
Spirometry	VC, FVC, FEV, FEV ₁ %
ECG	12 lead ECG with a Rhythm trace. On a computerized, self interpreting

Audiometry	To test the following frequencies: Air Conduction: 250, 500, 1000, 1500, 2000, 300, 4000, 6000, 8000 Bone Conduction: 250 – 4000 Hz
	SiSi and masking if required.
Radiography Chest PA	To be taken on a 15" x 12" plate @ 20 to 25 MAS and 48 to 55 KV
Cervical Spine AP *	To be taken on a 10" x 8" plate @ 50 to 60 MAS and 60 to 65 KV
Cervical Spine Lat *	To be taken on a 10" x 8" plate @ 30 to 32 MAS and 50 to 55 KV
Lumbar Spine AP *	To be taken on a 12" x 15" plate @ 60 to 80 MAS and 63 to 75 KV
Lumbar Spine Lat *	To be taken on a 12" x 15" plate @ 80 to 100 MAS and 77 to 85 KV
Mammography	
Ultra-sono-graphy	
*To be carried out whenever indicated.	

The Medical Officer (Occupational Health) is responsible for recording the findings in the workers' individual Periodical Medical Profiles and simultaneously in the Occupational Health System.

The Plant has a dedicated Health, Safety and Environment (HSE) Department which is responsible for looking after all Environment, Safety and Workers' Occupational Health aspects of the plant. The plant's HSE Department is in close contact with the HSE Departments at ONGC's Regional Office and at the Corporate Head Office.

The HSE is responsible for the purchase and issue of all personal protective equipment (PPE) e.g. shoes, helmets, various types of gloves, aprons, dust respirators, ear plugs, goggles etc. PPE are location specific. Safety boots are issued every year. Ear plugs and face masks are issued as and when required. If any PPEs are damaged before their scheduled replacement, fresh equipment are issued.

The HSE Department is responsible for issue of all necessary safety equipment to the workers.

The heads of individual units of the plant are responsible for ensuring all applicable safety procedures are followed. The Safety Officer has check lists for all work locations to monitor safety during operations. He conducts spot checks daily at randomly chosen locations to check whether safety practices are being followed. The Safety Officer and the concerned safety supervisors ensure the following:

- ❖ The Plant has a Work Permit for undertaking all repair and maintenance work. The necessary work permits must be taken before initiating any repair & maintenance work.
- ❖ All workers and visitors wear safety helmets in working areas
- ❖ All workers wear safety boots.
- ❖ All workers engaged in welding / gas cutting wear welders' goggles, gloves and masks
- ❖ Workers engaged in abrasive work, wear goggles and masks

- ❖ Workers engaged in handling heavy items and glass wear gloves.
- ❖ Personnel deployed near noisy machinery are provided with acoustic enclosures and / or issued ear plugs / ear muffs.
- ❖ Smoking is strictly prohibited in the plant area.
- ❖ The fire fighting systems (both automatic as well the manual back-up systems) at all locations are in working order.
- ❖ All hazardous wastes are carefully documented, packed and stored in the designated area before being dispatched to the contracted TSDF.
- ❖ Vehicles allowed inside the plant area are certified to be intrinsically safe.
- ❖ Heavy material handling machinery give audio-visual warnings while moving heavy loads.
- ❖ Workers working at heights are provided with safety belts / harnesses.
- ❖ All other general safety rules and guidelines are followed.

It is mandatory for all new recruits to undergo training on safety before being actually sent to work place. This training is organised by ONGC's Health Safety and Environment (HSE) Department. The HSE Department conducts class-room training on safety for all operational staff as well contractors' workers deployed for various works inside the plant. The training is imparted by ONGC's Safety Officer, Fire Officer, doctors and external experts. All workers also undergo refresher training on safety. Selected personnel are also sent for attending seminars and training courses at outside agencies.

4.10 HOUSEKEEPING

It is necessary to maintain a clean working area and surroundings for:

- Avoiding fire hazards
- Optimum utilization of the space available
- Ensuring hassle free evacuation during emergencies
- Reduction in pollution
- Maintenance of good relationship with nearby communities
- Good aesthetics

4.11 SUMMARY OF IMPACTS:

Based on the above evaluation the significance value of impact on various components of environment during construction and operation phases is summarized and is given in **Table 4.27**.

Table 4.27: Summary of Impact Evaluation in terms of Significance Value

Environmental component		Construction	Operation
Air		Low	Low
Water	Consumption of Raw Water	Low	Medium
	Generation of Effluent	Low	Low
Land	Land use & Topography	Low	-
	Soil Quality	Low	Low
Noise		Low	Low
Biological		Low	Low
Socio-Economic		Low	Low

CHAPTER – 5

ENVIRONMENTAL MONITORING PROGRAM

5.0 INTRODUCTION

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operations. With the knowledge of baseline conditions, the monitoring programmed will serve as an indicator for any deterioration in environmental conditions due to operation of the project, to enable taking up suitable mitigation steps in time to safeguard the environment. Monitoring is as important as that of pollution since the efficiency of control measures can only be determined by monitoring.

Usually, as in the case of the study, an impact assessment study is carried out over short period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environmental quality.

5.1 ENVIRONMENTAL MONITORING AND REPORTING PROCEDURE

Development of the programme during the planning process shall be conducted or supported by environmental specialists. However, the implementation responsibility rests with working managers of ONGC-Uran, who should, therefore, ensure they fully understand and subscribe to the commitments being made. These commitments will include the legal and statutory controls imposed on the operation as well as other corporate commitment to responsible environment management.

ONGC has a dedicated a Health, Safety and Environment (HSE) Department at its Uran Plant. There is also a HSE Department at the Head Office. The plant HSE Department deals with all environment related issues and works of the plant. The department is headed by the very senior officer, who reports to the Group General Manager (the head of the Uran Plant). The plant HSE also reports to the HSE at the corporate head office. The plant HSE Department has two qualified environmental engineers. The HSE Department arranges for accredited laboratories for undertaking environmental monitoring. The HSE Department takes the help of other departments for development and maintenance of jobs like drainage, clearing settling pits, repair & maintenance of pollution control systems, pollution monitoring systems, disposal of oil sludge, unusable oil & lubricants and unserviceable equipment & scrap etc. For successful implementation of the environmental management plan other agencies of the State may also be involved by the plant if required (for regulatory requirement or technical support). The data collected on various EMP measures would be reviewed and if needed corrective action will be formulated for implementation. The typical organogram of ONGC-Uran HSE department is given below in figure 5.1.

Monitoring shall confirm that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a site using ecological / biological, physical and chemical indicators. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints.

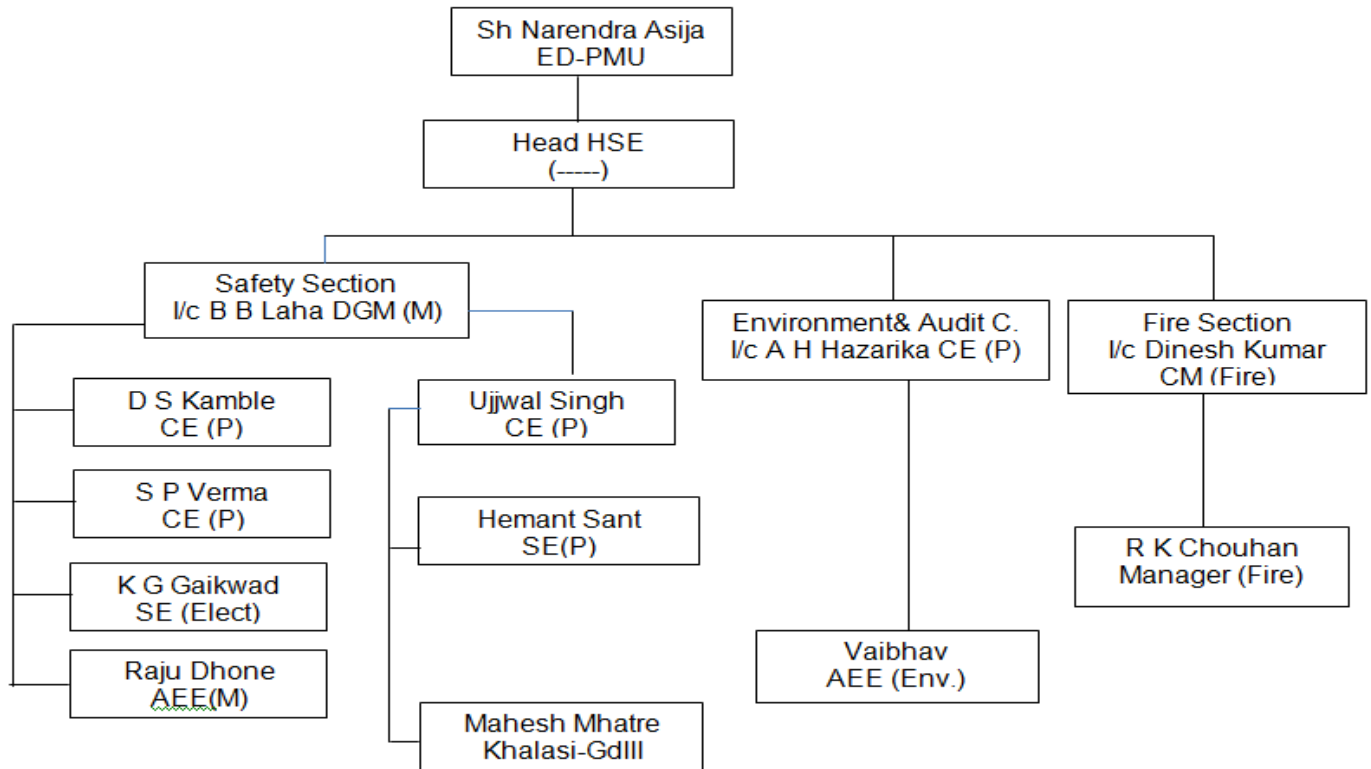


Figure 5.1 HSE Organogram of ONGC-Uran

5.2 OBJECTIVES OF MONITORING

To ensure the effective implementation of the proposed mitigation measures, the broad objectives of monitoring plan are:

- To evaluate the performance of mitigation measures proposed in the environmental monitoring programme.
- To evaluate the adequacy of Environmental Impact Assessment
- To suggest improvements in management plan, if required
- To enhance environmental quality.
- To undertake compliance monitoring of the proposed project operation and evaluation of mitigative measure.

5.3 CONSTRUCTION PHASE

Chapter 4 describes the impacts and mitigation measures envisaged during construction phase vis-à-vis the environmental components which are likely to get impacted in case mitigation measures are not adequately followed. In view of the same the environmental components / indicators which are to be monitored during construction phase are air, water, noise levels and soil. Due to limited construction activities, the environmental monitoring programme shall be accordingly arranged.

The environmental monitoring programme during construction phase is presented in Table 5.1. The implementation of monitoring will be contractor's responsibility and the supervision will be done by ONGC-Uran.

Table 5.1 Environmental Monitoring Programme– Construction Phase (2 years)

Component	Parameters	Location / Frequency of Monitoring	No. of Samples / year (Locations X Monitoring Frequency)
Air	SO ₂ , NO _x , PM ₁₀ &PM _{2.5}	At two locations, one at project site and another is at plant boundary. Twice in a season (except monsoon) per year for 2 years	4 x 3
Water	Surface Water: CPCB surface water criteria; Ground Water: IS:10500	One surface water in the project site per season. Two Ground Water: One Up-gradient and One Down-gradient of project site per season.	3 x 3
Noise	Noise Levels Leq (A)	At two locations, one at project site and another is at plant boundary. Once in a season (except monsoon) per year for 2 years	2 x 3
Soil	As per standard practice	At one location, in the project site. Twice in a year.	1 x 2

Note : Construction period is 2 years (24 months)

5.4 OPERATION PHASE

The components / indicators of different environmental monitoring program are as under.

5.4.1 Monitoring For Pollutants

As stated under Chapter 4, the environmental stresses from pollutants are marginal. Often the range of impact is limited to the plant and in its immediate vicinity, the monitoring schedule is evolved accordingly.

5.4.1.1 Work zone noise levels

ONGC-Uran will monitor the noise levels inside and around the plant on a quarterly basis. Extensive survey will be done in occupied areas near the sources of noise. Monitoring will be done in twelve places on site (Table 5.2). ONGC-Uran will keep a record of noise levels and take necessary organizational actions like rotation of workmen, availability and use of personal protective devices, damage to enclosures or insulation layers over enclosures and piping.

Table 5.2 Noise Level to be monitored

Description	Nos. of Locations	Monitoring Frequency
Work zone Noise	Eight hours per shift continuous to cover all shift of operation once in a quarter for all the twelve selected locations.	12 X 3 (shifts) per quarter = 36 x 4 samples per year
*Noise Level in Leq (A)		

5.4.1.2 Stack gas monitoring

The flue gas coming out from the stacks will be sampled and monitored for SO₂, NO_x, CO and PM. Monitoring of the flue gases will be done once a month or as prescribed by the Maharashtra Pollution Control Board (MPCB). There will be Two (02) stacks coming inside the plant for the proposed project and hence the number of sampling/ analysis per year will be 24.

5.4.2 Meteorology

The temperature, wind speed, wind direction, cloud cover, and rainfall shall be monitored and recorded daily. These data shall be used for detailed short term and long term predictions of atmospheric dispersion of the pollutants released from the stack.

5.4.3 Ambient Air Quality

It is necessary to monitor the air quality at the boundary of the plant specifically with respect to SO₂ and NO_x. The equipment at the continuous monitoring stations will have facilities to monitor PM₁₀, PM_{2.5}, SO₂ and NO_x. In addition Ambient Air Quality measurement for manually monitoring of the parameters in the plant and in the surrounding villages is required. The AAQ in villages will be monitored once in each month during the entire year except monsoon season.

After the implementation of the proposed project the ambient air shall be regularly monitored as given in Table 5.3 or as per the directives given by CPCB / MPPCB from time to time.

Table 5.3 Ambient air to be monitored

SI No	Description	Number of AAQ Stations	Monitoring Frequency
1.	Ambient Air Quality	3	Once in each month - 24 hr continuous (except monsoon) for PM _{2.5} , PM ₁₀ , SO ₂ & NO _x Continuous
* Parameters = PM _{2.5} , PM ₁₀ , SO ₂ and NO _x			

5.4.4 Waste Water from Project Site

There will be no liquid effluent generation from GT-IV unit. There will be 100 m³/day of effluent generation from ERTO unit. The liquid effluent (quantity <100 m³ per day), mainly brine solution of Sodium Sulfite (Na₂SO₃), shall be diluted with existing treated water (~ 3000m³ per day) from effluent treatment plant and finally discharged into sea (complying MPCB standards). Sodium Sulfite (Na₂SO₃) being white colored salt solution and all parameters like BOD, COD, TDS, TSS, PH shall be maintained as per MPCB norms, before discharging to sea, hence there shall be no adverse impact on Sea water. MPCB vide their Consent order No:-Formate1.0/ BO/CAC-Cell/ UAN No 11474/1st CAC-1709000522 dated 14.09.2017 has accorded consent to ONGC Uran plant to dispose treated effluent into sea.

5.4.5 Ambient Noise

Ambient noise shall be monitored at two locations in villages surrounding the plant, twice in each season.

5.4.6 Ground Water Monitoring

Ground water shall be sampled from wells / hand-pumps / tube-wells, up gradient and down gradient of the plant area and the residential area to check for possible contamination and to ascertain the trend of variation in the water quality, if any. In case any adverse trend is noticed, immediate remedial measures shall be taken. A total of four samples shall be monitored once in each month for the critical parameters.

5.4.7 Soil Quality Monitoring

Soil samples from one location in the project site shall be analysed twice a year.

5.4.8 Solid/Hazardous Waste Disposal

The solid waste that is produced during operation phase will be either sold as manure for agricultural fields or to brick and cement industries. Periodic surveillance monitoring will be conducted to ensure that the wastes are utilized in the manner as specified.

5.4.9 Green Belt Development

Out of a total available open area of 11665 sq.m., 7400 sq.m. is under green belt/cover. ONGC Uran has developed green belt around plant boundaries. Uran has planted 2234 plants in 7400 m² (approx.) area. Also developed Green grass carpet along the roads within the plant. More than two lakh trees were planted on Dronagiri hill through helicopter seeding. The plantation area is 2.74 sq km approximately. Besides the above, 1500 trees and 33500 mangroves were planted along RoU corridor of pipelines.

Green belt development and plantation in and around the plant shall continue to improve the green cover in the area. The data on area of green cover, survival rate etc are compiled for periodic review. The following plans are made for future program:

- Annual plans for tree plantation with specific number of trees to be planted shall be made. The fulfillment of the plan is monitored by ONGC's HSE Department.
- Watering of the plants, manuring, weeding, hoeing is carried out for minimum 3 years.

ONGC-Uran shall continue to plant more plants inside and outside the plant premises which may be suitably identified.

5.4.10 Socio-Economic Development

The proposed project will improve the infra-structure & socio-economic conditions thus will enhance the overall development of the region. The communities, which are benefited by the plant, are thus one of the key stakeholders. It is suggested that the plant management under Corporate Social Responsibility (CSR) plan will have structured interactions with the community to disseminate the measures planned / taken by ONGC-Uran and also to elicit suggestions from stake-holders for overall improvement for the development of the area.

5.4.11 Occupational Safety and Health

All workers undergo a pre-employment medical examination. They also undergo subsequent Periodical Medical Examination (PME) to ascertain any changes in health condition due to the working conditions. Workers whose age is less than 40 years undergo PME every alternate year. Workers more than 40 years old undergo PME every year. The medical examination is carried out by a qualified occupational health physician.

5.5 SUBMISSION OF MONITORING REPORTS TO MoEFCC

As per the requirements, the status of environmental clearance stipulation implementation will be submitted to MoEFCC in hard and soft copy on 1stDecember and 1stJune of every calendar year. These reports will be put up on MoEFCC web site as per their procedure and will be updated every six months. The pollutants will be monitored on monthly basis and reports will be submitted to MPCB and CPCB respectively, as per the requirements.

CHAPTER – 6

ENVIRONMENTAL MANAGEMENT PLAN

6.1 ENVIRONMENT MANAGEMENT

Environmental Management Plan (EMP) is planning and implementation of various pollution abatement measures for any proposed project. The EMP lists out all these measures not only for the operational phase of the plant but also for the construction phase and planning phase. The EMP is prepared keeping in view all possible strategies oriented towards the impact minimisation.

The EMP for the proposed project is divided into two phases i.e. Construction and Operational phase. The planning phase lists out the control strategies to be adopted during the design considerations. The construction and operational phase details the control/abatement measures to be adopted during these phases.

6.1.1 ENVIRONMENTAL MANAGEMENT AT PLANNING PHASE

Design Considerations

Government of India has made many legislations/rules for the protection and improvement of environment in India. Various environmental legislations/rules applicable to the proposed project facilities are given in **Table 6.1**.

Table 6.1 Indian Environmental Legislation/Rules

Legal Instrument	Relevant articles/provisions
The Environment (Protection) Act, 1986, amended up to 1991	Section 7: Not to allow emission or discharge of environmental pollutants in excess of prescribed standards Section 8: Handling of Hazardous substances Section 10: Power of entry and inspection Section 11: Power to take samples Section 15 – 19: Penalties and procedures
Environment (Protection) Rules, 1986 (Amendments in 1999, 2001, 2002, 2002, 2003, 2004, March 2008)	Rule 3: Standards for emissions or discharge of environmental pollutants Rule 5: Prohibition and restriction on the location of industries and the carrying on process and operations in different areas Rule 13: Prohibition and restriction on the handling of hazardous substances in different areas Rule 14: Submission of environmental statement
The Air (Prevention and Control of Pollution) Act 1981, as amended upto 1987.	Section 21: Consent from State Boards Section 37: Penalties and Procedures
MoEF notification dated November 18, 2009 vide circular no G.S.R 186(E) for ambient air quality	National Ambient air quality standards
The Water (Prevention and Control of Pollution) Act, 1974, as amended upto 2003.	Section 24: Prohibition on disposal Section 25: Restriction on New Outlet and New Discharge Section 26: Provision regarding existing discharge of sewage

Legal Instrument	Relevant articles/provisions
	or trade effluent
EIA Notification 2006 and subsequent amendments	Requirements and procedure for seeking environmental clearance of projects
Noise Pollution (Regulation and Control) Rules, 2000, amended up to 2010.	Ambient noise standards and requirements of DG sets
Manufacture storage and import of hazardous chemicals rules 1989 amended 2000	Rule 4: Responsibility of operator
MoEF notification dated March 18, 2016 vide circular no G.S.R 320(E) for Plastic Waste (Management and Handling) Rules	Section 8: Responsibility of waste generator
MoEF notification dated March 23, 2016 vide circular no G.S.R 338(E) for e-waste (Management) Rules	Section 5: Responsibility of producer
MoEF notification dated April 4, 2016 vide circular no G.S.R 338(E) for Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	Section 4: Responsibilities of the occupier for management of hazardous and other wastes Section 6: Grant of authorisation for managing hazardous and other wastes Section 8: Storage of hazardous and other wastes Section 9: Utilisation of hazardous and other wastes
MoEF notification dated April 8, 2016 vide circular no G.S.R 1357(E) for Solid Waste Management Rules, 2016	Section 4: Duties of waste generators
EPA Notification [GSA 475(E), 5th May, 1992]	Bagasse fired boiler emission standard.

Proposed project shall be designed taking into account the above-referred legislations/rules and as per the directives of Environmental Clearance documents. Besides this the proposed effluent and emission standards will also be compiled for this Project.

During the design stage, all piping and instrumentation diagrams and plant layout shall be reviewed as a part of HAZOP/HAZAN studies to assess the risks involved.

The mitigation measures for the potential negative impacts anticipated from the proposed project and environmental monitored schedule are described in this chapter.

6.2 ENVIRONMENTAL MANAGEMENT DURING CONSTRUCTION PHASE

The overall impact of the pollution on the environment during construction phase is localized in nature, reversible and is for a short period. Various measures planned for management of various components of environment are given in subsequent sections.

6.2.1 Air Environment

Construction phase (Impact significance: Low)

- Preventive maintenance of vehicles and equipment.
- Vehicles with valid Pollution under Control certificates to be used.
- Unnecessary engine operations to be minimized.
- Implementing dust control activities such as water sprinkling on unpaved sites.
- Controlled vehicle speed on site.
- Vehicle to be covered during transportation of material
- Providing dust collection equipment at all possible points
- Following care would be taken for management of air quality during construction phase
 - The storage and handling of soil, sub-soil, topsoil and materials will be carefully managed to minimize the risk of wind blow down material and dust
 - There will be no on-site burning of any waste arising from any construction activity.
 - Dust masks should be provided to construction workers, while carrying out operations that may entails potential for dust generation.

6.2.2 Water environment

Construction phase (Impact significance: Consumption of water - Low)

- Sewage and grey water from construction camps and work sites.
- Cleaning and washing water for vehicle and equipment maintenance area.
- During construction phase, used construction water is the only effluent generated due to construction activities and most of the effluent generated will be so small that it will either get percolated to ground or get evaporated.

Construction phase (Impact significance: Generation of effluent - Low)

- Monitoring water usage at construction camps to prevent wastage.
- Ensuring there are no chemical or fuel spills at water body crossings.
- Marginal additional sanitary water will be routed to new STP.
- Usage of existing toilets for construction staff.

Rainwater Harvesting

Considering the climatic conditions and the scarce surface as well as groundwater availability in the region, state of the art rain water harvesting system is strongly recommended in the proposed project. The run-off from the most of the paved surfaces could be routed through a suitably designed storm water drainage system and collected in storm water collection sump. For augmenting the ground water resources in the proposed plant premises, number of rainwater harvesting wells could be constructed with internal drains where excess rain water flowing in drain could be diverted to rain water storage sumps for reuse.

To facilitate water harvesting, collection and storage of rainwater, the rain water storage system needs to be located at an appropriate location on the site keeping in view the slope contours and collection point. Provision should also be made for temporary collection of storm water and routing it to the water harvesting structures to recharge the ground water table. The designing of the system depends on various factors and needs to be undertaken during detailed engineering design of the project. The existing practice of rainwater storage by local villagers in the region may be studied for its implementation. Guidance from Central Ground Water Board (CGWB) could be taken for finalization of appropriate rain water harvesting technology. However, it must be ensured that these wells will be utilized only during monsoon and no wastewater should find way to these wells during operation phase of the refinery cum petrochemical complex.

6.2.3 Land environment

Construction phase (Impact significance: Land use & topography - Low, Soil quality - Low)

- Sufficient protective measures shall be adopted to avoid soil erosion during construction in the rainy season.
- Restricting all construction activities to the maximum possible extent inside the project boundary.
- The top-soil stock pile is not contaminated with any type of spills.
- Any material resulting from clearing and grading should not be deposited on approach roads, streams or ditches, which may hinder the passage and/or natural water drainage.
- After final site grading is complete, ensuring that the excess excavated material is not dumped indiscriminately but used for filling low lying areas construction by locals.
- Developing project specific waste management plan
- Developing and maintaining dedicated waste storage areas

6.2.4 Noise environment

Construction phase (Impact significance: Low)

- Preventive maintenance of equipment and vehicles
- Unnecessary engine operations to be minimized (e.g. equipment with intermitted use switched off when not working)
- DG sets to be provided with acoustic enclosures and exhaust mufflers.

6.2.5 Biological environment

Construction phase (Impact significance: Low)

- Avoid cutting of trees wherever possible, especially the endangered species observed in the study area.
- Exploring opportunities for conservation of endangered species.
- Closing of trenches as soon as possible of construction.
- Prevent littering of work sites with wastes, especially plastic.
- Training of drivers to maintain speed limits and avoid road-kills.

6.2.6 Socio-economic environment

Construction phase (Impact significance: Low)

- Training contractors on company safety policy requirements
- Monitoring speed and route of project-related vehicles within the project area
- Determine of the safe, legal load limits of all bridges and roads that will be used by heavy vehicles and machinery.
- Upgrading local roads, wherever required, to ensure ease of project activity and community safety
- Consolidating deliveries of materials and personnel to project sites, whenever feasible, to minimize flow of traffic
- Minimizing interruption of access to community use of public infrastructure
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Monitoring construction camp safety and hygiene
- Preventing use of drugs and alcohol in project-sites
- Preventing possession of firearms by project-personnel, except those responsible for security
- Project-related waste and wastewater is disposed in a responsible manner

6.3 ENVIRONMENTAL MANAGEMENT DURING OPERATION PHASE

The overall impact of the pollution on the environment during operation phase is localized in nature, non-reversible and is for a long period. Various measures planned for management of various components of environment are given in subsequent sections.

6.3.1 Air Environment

Operation phase (Impact significance: Low)

- Ensuring preventive maintenance of equipment.
- Monitoring of air polluting concentrations.

6.3.2 Water environment

Operation phase (Impact significance: Consumption of water -Low, Generation of effluent - Low)

- Tracking of consumption.
- Development of rainwater harvesting pits
- Maximum Utilization Of Treated Water
- Zero liquid discharge concept to be adopted.

6.3.3 Land environment

Operation phase (Impact significance: Low)

- Solid waste in the form of ash from lignin (which is used as fuel in boiler).
- The solid waste that is produced during operation phase will be either sold as manure for agricultural fields or to brick and cement industries.

6.3.4 Noise environment

Operation phase (Impact significance: Low)

- Avoiding continuous (more than 8 hrs) exposure of workers to high noise areas.
- Provision of ear muffs at the high noise areas
- Ensuring preventive maintenance of equipment.

6.3.5 Biological environment

Operation phase (Impact significance: Low)

- Development of greenbelt is of prime importance due to their capacity to reduce noise and air pollution impacts by attenuation/assimilation and for providing food and habitat for local macro and micro fauna.
- Survival rate of the planted trees should be closely monitored and the trees, which could not survive should be replaced by more tolerant native species.
- Social awareness program about the importance of conservation of flora and fauna especially medicinal plants, rare and endangered species and their ecological role need to be conducted.
- Plantation and maintenance of additional trees during operation phase.

6.3.6 Socio-economic environment

Operation phase (Impact significance: Low)

- Employment opportunity may be provided to local people during operation phase considering their skills and abilities as per procedures & practices adopted by company.
- It must be ensured that the agricultural activity near the project sites must not get affected.
- Required collaboration between project authority and local bodies is necessary for the smooth functioning of the project as well as for the progress of the region.
- The facilities like education, medical, transportation, sanitation are poor in rural area. This provision needs to be strengthened under social welfare activity.
- For all the social welfare activities to be undertaken by the project authorities, collaboration should be sought with the local administrations viz. Gram Panchayat, C.D. Block office etc. for better co-ordination and also to reach to the public.
- Sanitation facilities in rural area are inadequate. The unsanitary conditions cause health problems. The medical facilities in the area are very poor. As such health camps for general health, eye check up, family planning, health awareness should be conducted for the rural people.
- Communication with the local community should be institutionalized & done on regular basis by the project authorities to provide as opportunity for mutual discussion.
- Project authorities should organize regular environmental awareness programmes to bring & environmental management measures being undertaken for improving their quality of life.

For social welfare activities to be undertaken by the project authorities collaboration may be sought with local administration gram panchayat block development office etc for better co-ordination

6.4 MEASURES FOR IMPROVEMENT OF BIOLOGICAL ENVIRONMENT

The resultant ambient air quality levels after the operation of the plant will be within the prescribed limits; impact on flora and fauna is not envisaged. The following recommendations are suggested for further implementation:

- Clearing of existing vegetation should be kept to minimum and should be done only when absolutely necessary;

- Plantation programme should be undertaken in all available areas. This should include plantation in the expanded areas, along the roads, on solid waste dump yards etc;
- Use of biogas, solar energy, should be encouraged both at individual and at society levels; and
- Plantation should be done along the roads, without affecting plant operational safety. This will not only improve the flora in the region but will add to the aesthetics of the region.

6.4.1 Greenbelt Development Plan

Out of a total available open area of 11665 sq.m., 7400 sq.m. is under green belt/cover. ONGC Uran has developed green belt around plant boundaries. Uran has planted 2234 plants in 7400 m² (approx.) area. Also developed Green grass carpet along the roads within the plant. More than two lakh trees were planted on Dronagiri hill through helicopter seeding. The plantation area is 2.74 sq km approximately. Besides the above, 1500 trees and 33500 mangroves were planted along RoU corridor of pipelines.

Green belt development and plantation in and around the plant shall continue to improve the green cover in the area. A detailed greenbelt plan and suggested plant species for plantation purpose has been presented in subsequent section. A budget of Rs. 80 lakhs is allocated for plantation activities. ONGC-Uran will plant and look after the planted species taking suggestions of appropriate consultant for greenbelt development.

6.4.2 Guidelines for plantation

The plant species identified for greenbelt development will be planted using pitting technique. The pit size will be either 45 cm x 45 cm x 45 cm or 60 cm x 60 cm x 60 cm. Bigger pit size is preferred on marginal and poor quality soils. Soil proposed to be used for filling the pit will be mixed with well decomposed farm yard manure or sewage sludge at the rate of 2.5 kg (on dry weight basis) and 3.6 kg (on dry weight basis) for 45 cm x 45 cm x 45 cm and 60 cm x 60 cm x 60 cm size pits respectively. The filling of soils will be completed at least 5 - 10 days before the actual plantation. Healthy seedlings of identified species will be planted in each pit.

6.4.3 Species Selection

Based on the regional background and soil quality, greenbelt will be developed. In greenbelt development, monocultures are not advisable due to its climatic factor and other environmental constrains. Greenbelt with varieties of species is preferred to maintain species diversity, rational utilization of nutrients and for maintaining health of the trees. Prepared in this way, the greenbelt will develop a favorable microclimate to support different micro- organisms in the soil and as a result of which soil quality will improve further.

During the course of survey, it has been observed that the soil quality of the plant site is fairly good and can support varieties of dry deciduous plant species for greenbelt development. Manure and vermin-compost may be mixed with the soil used for filling the pit for getting better result for survival of plant species. Adequate watering is to be done to background, extent of pollution load, soil quality, rainfall, temperature and human interactions, a number of species have been suggested to develop greenbelt inside and outside the ONGC-Uran plant. These species can be planted in staggering arrangements within the plant premises. Some draught resistant plant species have been identified which can be planted for greenbelt development if sufficient water is not available (CPCB book on Guidelines for Developing Greenbelts). The suitable

species for greenbelt development program are given in Table 10.2 to maintain the growth of young seedlings.

Table 6.2 Suggested species for plantation in greenbelt development

Sl. No.	Binomial name	Family	Type of planting
1.	<i>Anthocephaluscadamba</i>	Rubiaceae	All areas
2.	<i>Alstoniascholaris</i>	Apocynaceae	Township
3.	<i>Bambusaarundinaceae</i>	Poaceae	Plant Boundary limits
4.	<i>Bambusa vulgaris</i>	Poaceae	Plant Boundary limits
5.	<i>Calophylluminophyllum</i>	Clusiaceae	All areas
6.	<i>Courouppitaguianensis</i>	Lecythidaceae	All areas
7.	<i>Hibiscus tiliaceous</i>	Malvaceae	All areas
8.	<i>Lagerstroemia reginae</i>	Lythraceae	All areas
9.	<i>Bassialatifolia</i>	Sapotaceae	All areas
10.	<i>Ailanthesexcelsa</i>	Simaroubaceae	Avenue trees
11.	<i>Mangiferaindica</i>	Anacardiaceae	Avenue trees
12.	<i>Manilkarahexandra</i>	Sapotaceae	All areas
13.	<i>Mimusopselengi</i>	Sapotaceae	All areas
14.	<i>Plumeriaacuminata</i>	Apocynaceae	Plant Boundary limits
15.	<i>Plumeria alba</i>	Apocynaceae	Plant Boundary limits
16.	<i>Plumeriarubra</i>	Apocynaceae	Plant Boundary limits
17.	<i>Syzygiumcumini</i>	Myrtaceae	All areas
18.	<i>Terminaliaarjuna</i>	Combretaceae	Avenue trees
19.	<i>Terminaliacatappa</i>	Combretaceae	All areas
20.	<i>Thespesiapopulnea</i>	Malvaceae	All areas
21.	<i>Ficusbenghalensis</i>	Moraceae	Avenue trees
22.	<i>Ficusreligiosa</i>	Moraceae	Avenue trees
23.	<i>Ficusracemosa</i>	Moraceae	Avenue trees
24.	<i>Ficusmicrocarpa</i>	Moraceae	Avenue trees
25.	<i>Murrayapaniculata</i>	Rutaceae	Township
26.	<i>Phyllanthusemblica</i>	Euphorbiaceae	All areas
27.	<i>Tectonagrandis</i>	Verbenaceae	Avenue trees
28.	<i>Cassia siamea</i>	Caesalpiniaceae	Avenue trees
29.	<i>Cassia fistula</i>	Caesalpiniaceae	Township

The species suggested here are commonly seen around the project area, fast growing and drought resistant. Seedlings / saplings of these species can be easily procured from local nurseries. The selection of plant species for the green belt development depends on various factors such as climate, elevation and soil. The plants suggested for green belt were selected based on the following desirable characteristics.

- Fast growing and providing optimum penetrability.
- Evergreen with minimal litter fall.
- Wind-firm and deep rooted.
- The species will form a dense canopy.

- Indigenous and locally available species.
- Trees with high foliage density, larger of leaf sizes and hairy on surfaces.
- Ability to withstand conditions like inundation and drought.
- Soil improving plants, such as nitrogen fixing plants, rapidly decomposable leaf litter.
- Attractive appearance with good flowering and fruit bearing.
- Bird and insect attracting plant species.
- Sustainable green cover with minimal maintenance
- Species which can trap/sequester carbon

6.4.4 Phase wise Greenbelt Development Plan

Greenbelt will be developed in a phase wise manner right from the construction phase of the proposed project. In the first phase along with the start of the construction activity all along the plant boundary, open space areas, and major roads will be planted. In the second phase the office building like Canteen, Administrative building, Fire Safety office area and other constructed buildings will be planted. In the third phase when all the construction activity is complete plantation will be taken up in the gap areas of plant area, around different units, in stretch of open land and along other connecting roads, parks and residential quarters.

The total construction period is 24 months from the date of starting of construction. The first phase of the plantation programme will start immediately with the start of construction and run upto 12 months. The second phase will start after 12 months and continue upto 24 months.

6.5 IMPLEMENTATION OF EMP IN CONSTRUCTION PHASE

The overall impact of the pollution on the environment during construction phase is localised in nature and is for a short period at all sites. In order to develop effective mitigation plan, it is important to conceive the specific activities during construction phase causing environmental impact.

All the construction activities are undertaken, controlled and managed by EPC contractor with the guidance of PMC consultant. It is mandatory for EPC contractor to develop site/project specific HSE Policy, HSE Plan, HSE management system for complete EPC phase of the project. The various HSE requirements/Deliverables that will be developed is given in **Table 6.3**.

Table 6.3 Elements of HSE Management System during EPC Phase

S.No.	Element of HSE Management System	HSE Requirements/Deliverables
1.0	Preservation	Development of Principal Environmental Flow Diagram and Environmental Balance
2.0	Progress	HSE Measurement Requirements
3.0	Durable Development	Implementation Plan for Environmental Management Plan indicated in Final EIA report (Approved by MoEF)
4.0	Regulation	Environmental Philosophy & Safety Philosophy
5.0	Prevention and Proactive Management of Risk	Implementation of findings of Risk Assessment Study
6.0	Continuous Improvement	

6.1		HSE Close out Report
6.2		HSE Audit Requirements
6.3		Project HSE Review
7.0	Formation and Sensitisation	HSE Training Requirements
8.0	Information and Communication	
8.1		HSE Communication Requirements
8.2		HSE Resources
8.3		Competency Requirements
8.4		HSE Documentation
8.5		HSE Records
8.6		HSE Procedures
9.0	Responsibilities	HSE Management System Requirements

6.5.1 Air Quality

As mentioned in Chapter-4, there will be minimal increase in particulate matter levels in ambient air during construction of proposed activities.

All the major dust generation construction activities will be regularly planned and controlled under the supervision of HS Manager. Records will be documented for the ambient air quality monitored before and during all dust generation construction activities. Necessary control and management will be taken at site by HS manager as appropriate. All such records will be reviewed for corrective and preventive action.

6.5.2 Noise Quality

Ambient noise levels measured at various locations within the study area are found within limits. All the major noise generation construction activities will be regularly planned and controlled under the supervision of HS Manager. As indicated in **Table 6.3**, Sl. No. 8.5 records will be documented for the ambient noise monitored before and during all noise generation construction activities. Necessary control and management will be taken at site by HS manager as appropriate. Also as indicated in **Table 6.3** of Sl. No. 6.3, all such records will be reviewed for corrective and preventive action.

6.5.3 Water Quality

All the major water consumption and waste water generation construction activities will be regularly planned and controlled under the supervision of HS Manager. As indicated in **Table 6.3** of S. No. 8.5 records will be documented for the total water supplied by tankers and wastage of the same shall be monitored before and during all such construction activities. Necessary control and management will be taken at site by HS manager as appropriate. Also as indicated in **Table 6.3** of S. No. 6.3, all such records will be reviewed for corrective and preventive action.

6.5.4 Socio-economic

The presence of highly skilled labour force around the plant area will ensure the availability of labour at construction site. This will lead to non-requirement of any kind of temporary housing near the construction site but may put stress in the existing transport system and traffic density. A proper traffic and man power management may reduce this problem in a substantial way. The health records of

all construction force will be collected and will be supervised by medical in-charge specially appointed by EPC Contractor.
Some of the measures recommended towards improvement in socio-economic environment are suggested as follows:

- a) Use of local labour to the maximum extent.
- b) Provision of minimum wages for construction workers as per the Madhya Pradesh State Government Norms.
- c) Strict compliance of all applicable labour laws of Centre/State Govt.
- d) Adequate sanitation and drinking water facilities
- e) Safety demonstration programmes, training to workers and provision of adequate personal safety equipment.
- f) Use of reliable and sound construction practices.

6.5.5 Biological Environment

The existing green belt shall be developed and extended in the existing plant complex.

6.5.6 Land Environment

Considering sustainable development in view the following alternative building materials in place of conventional materials are suggested. These building materials with low carbon foot print and very low embodied energy in use shall be promoted for alternate building material apart from quarrying material.

- a) Industrial waste fly ash can be used as alternative construction material. Fly ash has the properties of cement and very low embodied energy is used. In combination with cements. Fly ash can be used in building blocks, reinforced concrete also in plaster and masonry.
- b) *Pre-cast hollow concrete blocks*: These are manufactured using lean cement concrete mixes and extruded through block-making machines of egg laying or static, type, need lesser cement mortar and enable speedy construction as compared to brick masonry; the cavity in the blocks provides better thermal insulation, and also do not need external/internal plastering. These can be used for walling blocks or as roofing blocks along with inverted pre-cast Tee beams.
- c) *Pre-cast stone blocks*: Pre-cast stone blocks are of larger size than normal bricks. These are manufactured by using waste stone pieces of various sizes with lean cement concrete and enable a rationalized use of locally available materials. This saves cement, reduces thickness of stone walls, and eliminates the use of plasters on internal/external surface. Use native or quarried stone where available within the delivery radius <100–150 kms, which has a very low-embodied energy content, negligible transport energy costs, and needs only shaping. Light weight stone, which is made from cement and recycled aggregates or furnace clinkers, can also be a resourceful option.
- d) *Perforated brick masonry*: Perforated brick masonry comprises of high strength hollow bricks with perforations of 50%–60%. These perforations act as sound and heat insulators and provide considerable savings in materials.
- e) *Stabilized compressed earth blocks*: These blocks are made up of mud stabilized with 5% cement lime and compacted in block-making machines with no burning. The soil to be used for the blocks should have the requisite

- component of clay, silt, and sand. Soil-stabilized hollow and interlocking blocks can provide better thermal insulation
- f) *Composite ferrocement system*: This system is simple to construct and made of ferrocement, that is, rich mortar reinforced with chicken and welded wire mesh. This system reduces thickness of the wall and allows larger carpet area. Pre-cast ferrocement units in trough shape are integrated with RCC columns. Ferro cement units serve as a permanent skin unit and a diagonal strut between columns. Inside cladding can be done with mud blocks or any locally viable material.
 - g) Alternatively, rapidly renewable materials/products, which are made from small diameter trees and fast growing low utilized species harvested within a 10 year cycle or shorter such as bamboo, rubber, eucrasia, eucalyptus, poplar, jute/cotton stalks, and so on. Rubber trees are grown to harvest rubber and at the end of their useful life, they are cut down. Thus, rubber tree wood can be utilized as a substitute for other woods. Bamboo is a rapidly renewable plant, which grows in 4–7 years. Thus, products made from bamboo can also be utilized. These products include engineered products, bamboo ply boards, rubber, jute stalk boards, and so on.
 - h) Composite wood products such as hardboards, block boards, lumber-core plywood, veneered Panels, particleboards, medium/low density fiberboards made from recycled wood scrap from sawmill dusts or furniture industry bonded with glue or resin under heat and pressure, can also be used as low-energy finishes in interiors/partition walls.
 - i) Products, which utilize industrial waste such as wood waste, agricultural waste, and natural fibres like sisal, coir, and glass fibre in inorganic matrices like gypsum, cement, and other binders such as fibrous gypsum plaster boards etc. can also be used.
 - j) Products, which use recycled materials like glass, crushed stone and other waste, such as terrazzo or which are resource efficient finishes such as finished concrete flooring, ceiling tiles, and ceramic tiles are useful.
 - k) Gypsum board partitions use 62% gypsum, which can either be sourced naturally or is produced as a by-product of power plants. Thus, gypsum used for partitions can contain 100% postindustrial recycled content. Gypsum has high recyclability potential as well.

6.6 IMPLEMENTATION OF EMP IN OPERATION PHASE

All the operation activities are undertaken, controlled and managed by EPC contractor with the guidance of PMC consultant before the plant gets ready. It is mandatory for EPC contractor to develop site/project specific HSE Policy, HSE Plan, HSE management system for complete commissioning and operational phases of the project. The various HSE requirements that will be carried out by the HSE team of the organization are listed below:

- a. Review and assessment of adequacy of measures implemented as per Environmental Management Plan, Disaster Management Plan (Onsite and Offsite) and Emergency Preparedness Plan and all other measures suggested by Statutory Authorities.
- b. Monitoring of Environmental balance and its parameters and its compliance to requirements specified as per statutory requirements/design requirements.
- c. Mock Safety drills to assess the readiness of the control of major accidents and hazards

d. Conducting HSE audits and Reviews.

The environmental management plan during the operational phase of the plant shall therefore be directed towards the following:

- Ensuring the operation of various process units as per specified operating guidelines/operating manuals.
- Strict adherence to maintenance schedule for various machinery/equipment.
- Good Housekeeping practices.
- Post project environmental monitoring.

6.7 OCCUPATIONAL HEALTH

For the proposed project, action plan for the implementation of OSHA Standards as per OHSAS/USEPA is as shown below:

- Display of Occupational Health & Safety Policy;
- To comply with statutory legal compliance related to the OHC dept.;
- Develop Onsite and Offsite emergency plan as Emergency Procedures to respond to Potential Emergencies;
- Schedule Regular Emergency Evacuation Drills by active participation and evaluation as and when drill planned by safety department;
- Six monthly periodic medical examinations of all workers working with the hazardous process;
- Reporting of all incidence and accidents by Accident & Incidence Reporting System;
- Investigation of all incidence and accidents by Investigation Report System;
- MSDS of all chemicals of company;
- Review of first aid facility;
- Preparing first aider & its information at work place;
- Identifying training needs of all the departments;
- Awareness of Occupational Hazards & General health promotional in workers by conducting lectures for occupational health hazards in annual planner at training center;
- Up-keep of ambulance & OHC by maintaining records.

6.7.1 Health

In order to provide safe working environment and safeguard occupational health and hygiene, the following measures will be undertaken:

- Periodic compulsory medical examination for all the plant employees as per OSHA requirement and specific medical examination.
- All the employees shall be trained in Health, Safety and Environment (HSE) aspects related to their job.
- Exposure of workers to noise, particularly in areas housing equipment which produce 85dB(A) or more will be monitored by noise decimeters. Audiometric tests are also done at periodic intervals for all the plant employees.

Regular (6 monthly) periodic medical checkup of contract and subcontract workers working at hazardous processes is done as per clause 68 T of Factory's Act.

6.8 DEVELOPMENT STRATEGY OF THE AREA

6.8.1 Social Responsibility

The local population shall be supported to take up the opportunities afforded by the increased economic activities in the area. Efforts shall be made to promote concord with the local populace. Further, the positive perceptions of the local people about the project shall be consolidated by enabling socio-economic development activities such as up gradation of health facilities and educational infrastructure in coordination/association with the local government /development agencies in area.

6.8.2 Energy Conservation measures

Properly implemented energy saving measures may reduce considerable amount of expenditure and emission of green house gases. Various measures have been envisaged in the Project area to conserve energy.

The suggested measures are as follows:

- a) Use of CFL/LED.
- b) Use of Low-pressure sodium lamps for outdoor lighting along the road and security lighting with Solar Street Lights mix.
- c) Solar lighting will be provided in the main control room and in areas where safety related equipment are located.
- d) Use of solar water heaters for hospital, guest house.
- e) Automatic timing control mechanism will be incorporated in the street lighting to save energy. Mechanism will involve staggering of on-off sequence of street lights.
- f) Designing the structures having proper ventilation and natural light.
- g) The hostels, guest house, hospital etc. shall have solar water heating systems. The street lights shall have 20% mix of solar lights.
- h) The street lighting shall be controlled by staggering of putting on-off of lights in particular sequence.

6.8.3 Use of Renewable and Alternate Source of Energy

A detailed survey of the site is carried out during environmental data collection for use of renewable and alternate source of energy such as wind energy and solar energy. However, based on techno-economic considerations, the following are suggested:

- a) Use of solar heaters and solar lights at public buildings such as guest houses, canteens, hospital etc
- b) Use of solar lights for street lighting limited to 20%. The street lighting shall be controlled by staggering of putting on-off of lights in particular sequence.

6.8.4 Development of Carbon Manual

Also to demonstrate the need of sustainable use of fossil fuels, carbon foot print will be assessed using customized software and will be widely publicized.

6.8.5 Corporate Environment Responsibility Activities

Various CER activities will be carried out by ONGC-Uran in surrounding area with budget for the next 3 years are given in **Table 6.4**.

Table 6.4 Details of CER Budget

S. No.	Particulars	Amount (in Rs. Lakhs)		
		2019-20	2020-21	2021-22
1	CER Budget	53	53	53

Various CER activities are: Solar Lighting/Solar pump (Irrigation) system Drinking Water Facilities, Air quality monitoring in surrounding area etc.

6.9 ESTIMATED COST FOR IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT PLAN

Considering all measures suggested above, cost is worked out for implementation of environmental management plan and is given in **table 6.5 & 6.6**. The total estimated budget for implementation of EMP is worked out as Rs. 166 Lakhs towards capital cost and Rs. 55 Lakhs towards recurring cost per annum.

Table 6.5: BUDGET OF ENVIRONMENTAL MANAGEMENT PLAN (Capital Cost)

Sl. No.	Activity	Budget (Rupees in Lakhs)
1.0	Air Environment	
1.1	Plantation Activities (Trees and Shrubs)	80.0
1.2	Air quality monitoring	60.0
2.0	Noise Environment	
2.1	Additional Plantation Activities	Included in 1.1
2.2	Audiometric tests	2.0
3.0	Water Environment	
3.1	Rain water Harvesting pits	20.0
4.0	Land Environment	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Solid waste management	4.0
5.0	Biological Environment	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Capital Cost)	166.0

**Table 6.6: BUDGET OF ENVIRONMENTAL MANAGEMENT PLAN
(Recurring Cost per Annum)**

Sl. No.	Activity	Budget (Rupees in Lakhs)
1.0	Air Environment	
1.1	Additional Plantation Activities (Trees and Shrubs)	20.0
1.2	Air quality monitoring	20.0
2.0	Noise Environment	
2.1	Additional Plantation Activities	Included in 1.1
2.2	Audiometric tests	1.0
3.0	Water Environment	
3.1	Rain water Harvesting pits	5.0

3.2	Additional storage tank for treated wastewater and distribution network	5.0
4.0	Land Environment	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Solid waste management	4.0
5.0	Biological Environment	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Recurring Cost per Annum)	55.0

6.10 Quality, Safety, Health and Environmental Policy

ONGC is having well documented Quality, Environment, Occupational Health and Safety Policy for the workers and employees who are working in the Plant. The Environment policy of ONGC is given below as Figure 6.1.

शशि शंकर
Shashi Shanker
अध्यक्ष एवं प्रबन्ध निदेशक
Chairman & Managing Director



ऑयल एण्ड नेचुरल गैस कॉर्पोरेशन लि.
Oil and Natural Gas Corporation Ltd.

Corporate Environment Policy

Oil and Natural Gas Corporation Limited (ONGC) is committed to:

1. Achieve Environmental Leadership in all its Business Activities.
2. Abide by all applicable Legislative & other requirements associated with Environment Protection and Ecological Preservation.
3. Strive for Environment Protection and maintain Ecological Balance in and around its Operational areas for Sustainable Development.
4. Ensure Conservation of Natural Resources.
5. Enhance Community Awareness towards the Environmental Risks associated with Exploration & Production activities, mitigation measures undertaken and preparedness to tackle emergencies; to minimize its impact on Environment.
6. Minimize Waste Generation through Reduction at Source, Recycling & Reuse.
7. Maximize Recovery of Oil from Oily Waste and to exercise options for Utilizing Oily Waste for Energy purposes, wherever possible.
8. Prevent, Respond, Contain & Combat Oil Spill at Offshore & Onshore areas and ensure maximum reclamation of Oil.
9. Develop and Implement action plan on Social Needs around its Operational areas to meet obligations of Enterprise Social Responsibility.
10. Reduce Emissions at Source by adopting Clean and Green Technologies and phase out usage of Hazardous Substances in its Operations.
11. Meet provisions of Climate Change Treaty in line with Intended Nationally Determined Contribution targets of the Government of India including other applicable International Treaties.
12. Achieve Excellence in Knowledge Management and Skill Development for Environment Protection.


(Shashi Shanker)

Dated: 28th May, 2018

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Figure 6.1 Corporate Environment Policy of ONGC

CHAPTER – 7

ADDITIONAL STUDIES

7.0. ADDITIONAL STUDIES

In Addition to the main EIA study, following additional special studies have been carried out by independent institutes/agencies, organized by ONGC as well as EIL for generation of important baseline data / specific information required for the subject EIA study. The details of the same are presented below.

7.1 EMERGENCY PROCEDURES

An emergency may arise due to many reasons and various incidents. Four major scenarios have been envisaged and emergency procedures have been described in detail. In any other kind of emergency situation, the described emergency procedures under envisaged scenario will be a guiding basis of information and procedure.

To take care of emergencies which may occur during various activities ONGC has prepared a Emergency Response & Disaster Management Plan (ERDMP) for the Uran Oil & Gas Processing Plant. The ERDMP contains instructions to be followed in case of an emergency, major or serious accident, failure of system / equipment, fire or explosion, leakage of hazardous chemicals (including combustible liquids & gases), etc.

The envisaged scenarios are:

1. Fire / Explosion
2. Oil spill
3. Mercaptan leak
4. Chlorine leak

7.1.1 Fire / Explosion

As detailed above, most of the work areas of the plant are hazardous and fire-prone. In the Uran Plant, fire and explosion can be due to several reasons. Even a small fire can lead to a major fire if not controlled timely. This can have disastrous consequences on the plant itself, on the lives of plant personnel and on nearby communities.

To protect the working personnel and equipment from any damage or loss and to ensure uninterrupted processing of well fluids, adequate safety and fire fighting measures have been implemented at the plant. A Fire Emergency Procedure for controlling small fires is already in place and has been put into action during fire emergencies. However, LPG fire, oil storage tank fire or fire due to explosion of pressure vessels in the running units may be classified as disasters. Such an emergency cannot be controlled by the plant's personnel and assistance of the Central Industrial Security Force (CISF) personnel deployed at the plant and external agencies will be necessary.

Reporting Procedure

In the event of a fire / explosion, excess gas release in the plant or offsite, the person detecting the incident will report as follows:

- In case of fire: he or she will activate the nearest available Manual Call Point (MCP) which will automatically sound an alarm in the Fire Control Room indicating the fire's location. He or she may call 4444 / 4445 or 4120 / 4121 / 4122 from the nearest telephone.

- ❑ In case of gas leak / oil leak / leakage of hydrocarbons: Inform Control Room and Fire Control Room over telephone by dialing 4120 / 4121 / 4122 or 4444 / 4445 respectively from the nearest telephone.
- ❑ Will state his name and exact location and type of the emergency
- ❑ Person reporting the incident will remain near the location to guide emergency crew arriving at the scene.

Communication

- ❑ In the event, call is received by Process Control Room person, he will immediately convey the information to Fire Control Room, Shift in Charge and RPS.
- ❑ On receipt of fire call by Fire Control Room, the Shift I/C at the Fire Control Room will inform the Shift I/C RPS, Chief Manager Fire and Occupational Health Centre (OHC).

Immediate Actions

- ❑ Shift in-charge shall rush to the incident spot giving charge of Control Room to the next senior officer.
- ❑ Shift in-charge shall initiate first aid and fire fighting
- ❑ He shall take necessary operational measures to contain the emergency.
- ❑ He shall assess the magnitude of the incident
- ❑ He shall direct emergency mitigation operation and act as Incident Controller till RPS arrives at the location.
- ❑ Call the operational and maintenance persons as required.
- ❑ Fire crew shall proceed to the scene of emergency.
- ❑ In-Charge, Fire will proceed to the scene of the emergency. (In case he is not available, the senior most person present shall take over).
- ❑ RPS shall rush to the incident spot after getting information.
- ❑ RPS shall take charge as Incident Controller from Shift-in-charge and direct the emergency mitigation operations.
- ❑ He will assess the situation in consultation with In-Charge, Fire and will instruct Fire Control Room to sound Fire Siren and activation of EOCC if required.
- ❑ Inform Head Office, Head of Health Safety & Environment Department and PMU.
- ❑ Inform Vasudahara Control Room

Siren System and the Method of Reporting / Declaring

Alert Siren

A first alarm shall be sounded for 30 seconds continuously at the incipient stage when the fire is discovered and the plant fire services are put into action. It shall sound automatically due to breaking of glass of manual fire alarm point in the field or it can be sounded manually from the Fire Station (if not sounded in auto). In most of the cases the incident may be minor and relatively small numbers of people may be involved. The first run appliances viz. fire extinguishers, ambulance and crew consisting of the Duty Officers, regular fire crew and the auxiliary services are put on the service at the spot.

The incident Controller will decide whether the fire is a Minor Incident or a Major one.

Disaster Siren

- At incident spot: However small the incident may be, it can develop into a major emergency in which case a DISASTER SIREN is declared by actuating wailing siren

three times for a period of 30 seconds each at an interval of two minutes. This is sounded manually from Fire Station. In case of fire (after siren sounding) or hydrocarbon leak (when no alarm siren is sounded), if the need arises for evacuation then the Disaster Siren will be sounded from the Fire Station as per the instruction of the Incident Controller.

- At Fire Station: The raising of the DISASTER SIREN by the Fire station will be in event of Serious Fire or Explosion has already occurred.
- Or the occurrence of a subsequent second fire or damage likely to occur as a result of an accidental rupture of a tank or an operating vessel or major gas or hydrocarbon leak etc. In such cases DISASTER SIREN procedures will immediately swing into action as circumstances dictate.
- Or in case of fire (after Alert Siren sounding) or Hydrocarbon leak (when no alarm siren is sounded), if need arises for evacuation then the Disaster siren will be sounded from the Fire Station as per the instruction of the Incident Controller.

All Clear and Test Siren

- After the emergency situation is brought under control, the Incident Controller shall instruct the Control Room to announce the "All Clear".
- All Clear Siren shall be sounded only after announcement over the public address system from the Process Control Room.
- All Clear Siren will be sounded only if Alert Siren had been sounded. All Clear Siren and Test Siren, both will be blown for two minutes as straight siren. Test Siren will be operated on every Monday at 1100 hrs. Normal work will be resumed only after hearing the All Clear Siren.

Action on Hearing the Siren

- 1) All hot work in progress within the Plant must be immediately stopped. Fire water usage other than emergency handling must also be stopped.
- 2) Mobile equipment, like cranes, operating inside the affected unit, must be shut down after properly lowering the equipment hanging from the booms.
- 3) Persons not involved in handling the emergency must leave the area and report to the assembly area for further instructions.
- 4) CISF personnel must stop the traffic at all gates except: (a) Employees coming in from Mutual Aid Group (b) Fire Brigade (c) Emergency Vehicles e.g. ambulances.

Duties of Personnel

Uran Plant Manager

- To take overall command for emergency operations
- Assess the situation and if feels that the emergency can affect nearby communities, shall inform the District Collector
- Shall inform Director (Offshore) and the Chairman cum Managing Director

Head Operations

- After getting information from RPS / RE / Shift in charge rush to site of emergency. Assess the situation and direct further operations.
- Inform EOCC in charge i.e. Head, Engineering Services to activate EOCC at Dronagiri Bhavan / Uran Colony

- Co-ordinate with Offshore, Trombay Terminal and other consumers regarding feed / products flow.
- Call the Crisis Management Team
- Co-ordination with Incident Controller and Plant Manager, Uran regarding Plant shut-down and evacuation
- Communication with EOCC Ensure preservation of evidence

EOCC in Charge

Rush to EOCC at Dronagiri / Uran Colony Co-ordinate with Vasudhara Control Room Call all the following emergency Co-ordinators

- ❖ Head, Support Services
- ❖ Head Maintenance
- ❖ In Charge, Chemistry
- ❖ In Charge, Material Management
- ❖ In Charge, Finance
- ❖ In Charge, Medical
- ❖ In Charge, Infocom
- ❖ In Charge, Logistics Maintain log of all events Liaison with civic authorities

Head, HSE

- ❖ Direct RE (Safety) to ensure that all non-essential workers / staff of the affected areas are evacuated to assembly point
- ❖ Ensure safety of the unaffected plant
- ❖ Co-ordination with Medical Department and Fire Department
- ❖ Reporting to statutory authorities like DISH and MPCB

Head Maintenance

- ❖ Mobilise crew and equipment for mitigation of emergency
- ❖ Arrange any specialized equipment or services from outside if required

In Charge, Fire

- ❖ Rush to the site and assess the situation Direct the fire fighting and rescue operations Logistic and material support to the CISF Fire Wing Co-ordinate with incident controller
- ❖ Co-ordinate for additional help from Mutual Aid Resources Group

In Charge, Infocom

- ❖ Take charge of entire communication system and ensure its healthiness
- ❖ Arrange manual communication to nearest police station in case of total communication failure
- ❖ Maintain listed inventory in the control centres
- ❖ Communicate with Meteorological Office for latest weather conditions, earthquakes etc. Distribute communication equipment to all concerned and maintain record of issue

In Charge, Security

- ❖ Co-ordinate with Incident Controller
- ❖ Close the Visitor Gate and open the Emergency Gate
- ❖ Instruct all security personnel to remain at their posts unless directed otherwise

- ❖ Send information to Uran CISF Colony
- ❖ Ensure that no unauthorized person or vehicle enters the plant
- ❖ Arrange for the affected area(s) to be cordoned off and protect material
- ❖ Provide spark arrestor to all vehicles including fire tenders entering the plant premises
- ❖ Arrange for parking of vehicles
- ❖ Maintain head count in the plant in association with Infocom services
- ❖ In case of evacuation decision, ensure opening of gates

In charge, Occupational Health Centre

- ❖ Send an ambulance with Radio Trunking Set / walkie talkie and pharmacist
- ❖ Mobilise First Aid team
- ❖ Additional drugs, bandages etc., doctors, ambulances and hospitalization requirements
- ❖ Arrange to evacuate casualties to hospitals
- ❖ Maintain record of injuries / casualties

In charge, Human Resources-Emergency Response

- ❖ Liaison with civic authorities, police, press & media Issue authorized statement(s) to the news media Arrange rehabilitation works
- ❖ Ensure that casualties receive adequate attention and to inform the relatives
- ❖ Record of next of kith & kin contact details to be maintained for all employees (regular, contractual & direct) in association with Area in Charge Contract Cell
- ❖ Arrange water, refreshments, clothing accommodation

In charge, Material management

- ❖ Arrange supply of any item required by any of the co-ordinators, either from inventory or by emergency purchases
- ❖ Stores to be opened for extended hours for issuance of stock items and manning roster to be made.

In charge, Finance

- ❖ Arrange finance as required for emergency purchases
- ❖ Take care of insurance formalities
- ❖ Assess the damage caused to nearby areas

Fire Pump Operator

- ❖ Rush to Fire Water Pump House on hearing siren
- ❖ Maintain the fire water header pressure to desired level

Crisis Management Team Co-ordinator

- ❖ Call the team members and rush to site
- ❖ Work in co-ordination with incident / site controller for mitigating the emergency

Co-ordinators of Assembly Points

- ❖ Rush to respective assembly points Reassure the assembled persons Headcount at the assembly point
- ❖ Co-ordinate with Site Controller / EOCC

General Instructions

- All “Hot Jobs” must be stopped immediately
- Workers at canteen and Employees rest House must turn off all burners and isolate gas supply before leaving their work places.
- In absence of the persons mentioned above, the next senior-most person in the section shall perform respective duties.
- All general shift personnel should report at designated assembly points
- All shift personnel should remain alert at their places of posting and follow instructions of control room
- Only “C” gate shall remain open during emergency.

Fire Protection Facilities

The Uran plant has a fire water network which covers entire plant with 7.0 Kg/cm² pressure at remotest location with double headed fire hydrants. There are a total of 411 nos. fire hydrants. Fire hydrants are located every 30 m in hazardous areas. Fire hoses are kept in readiness at critical locations. Water monitors are also located at strategic locations. The entire fire water net is always kept in auto mode.

The Fire Water pump house has following fire pumps & water tanks:

Sl. No.	Equipment	Capacity	Nos.
1	Diesel Pumps	1000 m ³	5
2	Electrical Pumps	1000 m ³	4
3	Jockey Pumps	360 m ³	2
4	Water Tanks	18000 m ³	2

The fire water net work is maintained in auto mode with help of two jockey pumps.

The entire plant is equipped with the Water Ring Main System. It is equipped with the following facilities.

1. 02 Nos. Fire Water Storage Tanks, each has a pumpable capacity of 18000 m³
2. 05 Nos. Fire Water Main Pumps (Diesel Engine operated), each having capacity of 1000 m³/Hr. and differential pressure of 11.5 kg/cm²
3. 04 nos. Fire Water Main Pumps (Electric operated), each having capacity of 1000 m³ /hr. and differential pressure of 11.5 kg/cm²
4. 02 nos. Jockey Pump (Elect operated), each having capacity of 300 m³/hr. and differential pressure of 12 kg/cm²

Auto water spray systems are connected with fire water network at storage tanks, vessels, process areas, LPG Spheres & unit areas, LPG/ Crude/ condensate pumps and electrical cable galleries and transformers. Foam pourers and remote/manual High volume and long range foam cum water monitors at crude storage tanks and critical areas/locations have also been installed. This includes

- ❖ Water/Foam Monitors (750 /1000 GPM) : 150 nos.
- ❖ HVLRS Monitors (2000 / 4000 GPM) : 39 nos.
- ❖ Remote HVLRS Monitors (2000 / 4000 GPM) : 14 nos.

Rim seal foam fire protection system has been installed in crude oil storage tanks. Gaseous fire suppression systems have been installed in enclosed space such as TG enclosures, control rooms. Portable fire extinguishers of various cap (CO₂/DCP/Foam)

at strategic locations covering entire Plant have been provided. There are a total of 1126 Fire Extinguishers.

Alarm & Emergency Communication

- The entire plant is covered with MCP [Pull down Type manual call (Break Glass)] fire alarm system with fire fighter phone. Fire Alarm panel is located in the plant's Central Fire station and process control where indication of fire is received and monitored round the clock for responding any fire and emergency. Telephone and public address systems are provided.
- 18 nos. Walkie- talkie and 7 nos. VHF radio sets have also been provided in Fire – Tender and Fire control room. Emergency sirens have been installed at 11 different places of the plant respectively.

Fire & Gas Detection

The plant is equipped with 'Fire & Gas Detection' system. There are 572 fixed HC Gas Detectors and 95 Nos. of H₂S Gas Detectors throughout the plant which continuously monitor the presence of hydrocarbons as well as H₂S gases. In addition, there are 37 Nos. UV/IR Flame Detectors installed at various strategic locations in the plant for detection of fire / flame. The systems provide audio visual alarms in the process control room and audio alarm in the field operator's cabins. Smoke detectors have also been installed in control rooms, offices and other smoke vulnerable areas.

Fire and Gas Detection System are periodically checked and calibrated.

Fire Station

A fire station equipped with emergency communications and various types of fire tenders (Foam / DCP / Multipurpose / Emergency Tenders / Foam Nurser) manned on round the clock by two fire crews of CISF personnel is located in the plant. Fire crew can start Fire Tender within 20 seconds from the receipt of any fire/emergency call and reach at fire incidence site in the plant within 3-4 minutes in case of any fire and emergency. The resources of the fire station include:

- Foam Tender : 04 nos.
- Multipurpose Fire Tenders : 04 nos.
- Foam Nurser : 02 nos.
- DCP Tender : 01 no.
- Emergency Tender : 01 no.
- Fire Jeep : 01 no.
- SCBA Sets : 80 nos.

Fire fighting chemicals: Stock of DCP and foam are maintained in the Plant for emergency.

- ❖ Dry Chemical Powder(DCP) : 3625* Kg (4750) (approx.)
- ❖ AFFF 3% : 21352* Ltrs (77000) (approx.)

*excluding Fire Tenders/system

Mutual Aid Resources Group

Uran Plant is having mutual aid scheme with nearby industries – JNPT, Navy, Air Force, State & Municipal fire brigade and ONGC work centers.

The fire fighting network of the Uran Plant is conforming to the latest Oil Industry Safety Directorate (OISD) Standards. ONGC has also implemented the recommendations of the M.B. Lal Committee on fire safety at the Uran Plant. In fact the Uran Plant is the first installation in India to do so.

Brief description of Unit-wise Fire Fighting System

Crude Oil Tank farm

- ❖ At the Uran Plant there are eight Nos. "Floating Roof" crude oil storage tanks. Each tank is 14.4 m high, is 79 m in diameter and has the capacity to store 60,000 m³ of crude oil. There are 2 tanks within a dyke (i.e. a total of 4 dykes). There is a high chance of the 2nd tank within a dyke also catching fire if one of the tanks catches fire. Oil from the damaged tank(s) may spill over the bunds / dykes and flow into the storm water channel. A surface fire may occur. Also the perimeter roads for the tanks may become inaccessible due to intense heat and smoke from the fire.
- ❖ To prevent occurrence of fire in the first place, "Automatic Detection and Rim Seal Fire Protection System" has been installed. The system comprises of metallic detection tube and a number of pre-mixed foam modules equally spaced on the roof of each tank. Each unit is dedicated to the protection of an equal portion of the Rim Seal area. Low expansion foam is delivered to the entire Rim Seal and tank shell upon detection of fire. All the units on the 8 tanks are interfaced to a personal computer for display, monitoring control and configuration of the system from Process Control Room, Thus, the entire system can be controlled using a user friendly specially designed soft-ware. A Repeater Alarm Panel is placed in the central Fire Station.
- ❖ The event of fire occurring at rim seal is detected by a metallic Detection Tube placed circumferentially within the rim seal around the whole circumference of the Floating roof tank. The metallic detection tubing is connected to the detection unit that in turn is linked to individual foam release mechanisms. The extinguishing system includes seven (7) nos. of foam units to protect the entire rim seal area. Upon detection of fire, all the foam modules on each tank deliver foam to the rim seal area simultaneously to ensure fire extinguishing and prevention of re-ignition.
- ❖ Besides the Rim Seal Fire Protection System, each crude oil tank has 2 nos. dedicated Foam Fire Fighting systems which are designed to pour foam solution at the rim seal and foam dam area of the floating roof tanks. Aqueous film forming foam (AFFF) compound stored in bladder which is the integral part of the Foam Vessel. Water pressurizes the bladder by which the foam compound comes in the line through the foam proportionate. Each tank has 2 such vessels. The foam solution is fed to the foam maker which is placed at top of the tank trough pipeline. Water pressure forces the foam compound from the foam bladder and it is mixed with the water at the header. From the header the foam goes to the foam maker for aeration and discharge to the rim seal area and foam dam area by sliding through the inner shell of the tank. It is a manually operated system. The foam pourer system is being revamped to conform to OISD-166 standards.
- ❖ There is a manually operated water sprinkler system on the tanks, which is being revamped to meet OISD standards.
- ❖ High Volume Long Range Water cum Foam Monitors (HVLR) have been installed in the tank farm area. Each monitor's capacity is 2000 gallons per minute (GPM) and designed throw is 55 m. The monitors' layout has been designed to ensure discharge of

foam solution to the tanks' centre. Total 19 nos. fixed type HVLRs and 3 nos. mobile type HVLRs have been installed in accordance with OISD – 116 standards at the tank farm.

LPG Sphere Area

There are 4 nos. LPG storage spheres (which are being replaced) with a total capacity of 4500 m³. There is also a 350 m³ capacity sphere for propane storage. LPG and propane are stored at pressure of ~8 kg/cm². To prevent fire in the LPG & Propane storage area and to suppress any fire in this area, the entire area is encircled by a pressurized fire water ring which is equipped with sufficient numbers of fixed type water monitors and fire hydrants. The LPG spheres are also equipped with quartz bulb type automatic detection and suppression systems. There are also UV Detectors, Heat Detectors, Hydrocarbon LEL Detectors in the area to sense any leakage of hydrocarbons and detection of fire / excessive heat in the area. These are monitored continuously from the process control room through a computerized monitoring system. In case of fire, the excessive heat activates the water sprinklers and water drencher located at the spheres' crowns. The system is designed to operate automatically. However there is also manual back-up.

7.1.2 Oil Spill

If any oil spill takes place at the Uran Plant, Trombay Metering Station and Loading arm at BPCL Jetty at Jawaharlal Nehru Port "Oil Spill Response Contingency Plan" shall be followed to minimize loss of life, damage to property and the environment and ensuring continuation of processing of oil and gas. The objective of this plan is to counter oil spill belonging to TIER – I category as per the guidelines laid out by International Maritime Organisation (IMO). However in case of oil spill of TIER – II and TIER – III, outside help from oil spill control professionals and / or agencies shall be sought as and when required. "Oil Spill Response Contingency Plan" has been prepared in line with OISD Std.200 and Regional contingency Plan – Offshore West and in Consultation with Indian Coast Guard. It is a part of Onsite Disaster Management Plan (URN / ISO / DIO / S001). The responsibility chart will be as per the Onsite Disaster Management Plan.

7.1.3 Mercaptan Leak

If any mercaptan leak takes place at the Uran Plant "Mercaptan Leak Order" shall be followed to minimize the effect on persons working in the plant. Mercaptan Leak Order is part of the On-site Disaster Management Plan (URN / ISO / DIO / S001). The purpose of the Mercaptan Leak Order is to make every plant employee aware of his / her role in the event of Mercaptan leakage in the plant.

Emergency procedure in the event of mercaptan leak is as follows:

- Role of person noticing mercaptan leak: First inform the control room (Phone: 4120, 4121, 4122) and then Fire Section (Phone: 4444 / 4445) over telephone or over public address system. Disclose his / her identity, nature of leakage, location of incident. Do not break the fire alarm glass.
- To stop the leakage do the following:
 - a) Wear self contained breathing apparatus
 - b) Isolate the source of leakage. In case of leakage from valve gland, tighten the same and in case of tubing, isolate the tubing by closing upstream valve.
 - c) Continuously spray water over the mercaptan leak.

- Avoid contact of mercaptan with naked eyes.
- Role of Fire Station, Process Control Room and Incident Controller will be as per Onsite Disaster Management Plan.

7.1.4 Chlorine Leak

If any chlorine leak takes place at the Uran Plant “Chlorine Leak Order” shall be followed to minimize the effect on persons working in the plant and the environment. Mercaptan Leak Order is part of the On-site Disaster Management Plan (URN / ISO / DIO / S001). The purpose of the Chlorine Leak Order is to make every plant employee aware of his / her role in the event of Chlorine leakage in the plant.

Emergency procedure in the event of chlorine leak is as follows:

- Role of person noticing chlorine leak: First inform the control room (Phone: 4120, 4121, 4122) and then Fire Section (Phone: 4444 / 4445) over telephone or over public address system. Disclose his / her identity, nature of leakage, location of incident. Do not break the fire alarm glass.
- To stop the leakage do the following:
 - a) Wear self contained breathing apparatus
 - b) Isolate the source of leakage. In case of leakage from valve gland, tighten the same and in case of tubing, isolate the tubing by closing upstream valve.
 - c) Decontaminate the area by sprinkling lime powder.
 - d) If the leakage is not visible, then cotton waste soaked in ammonia water solution can be used to identify the source of leakage. This will generate white fumes at the leakage point. In case the leakage is from chlorine toner and beyond control, put Fibre Reinforced Plastic (FRP) hood over the leaking toner. If it is not covered by FRP Hood and switch on the blower. While capping the leaking toner, one must use the breathing apparatus.
 - e) If there is chlorine spillage, try to neutralize the spill by activating the neutralizing system.
- Avoid contact of chlorine with naked eyes.
- Role of Fire Station, Process Control Room and Incident Controller will be as per Onsite Disaster Management Plan

7.1.5 Leak Detection and Repair (LDAR) Protocol

Uran Oil & Gas Processing Plant has installed a number of gas detectors inside the plant to detect any leakage of hydro-carbons inside the plant. Ethyl mercaptan is added to LPG as its strong odor indicates LPG leakage. Any person detecting any gas leak /oil spill/leakage of hydrocarbon has to inform the Process Control Room and the Fire Control Room. He / she has to stay at site for further information or till arrival of Shift In-charge & RPS.

The process is also constantly monitored. Any unusual drop in pressure / flow rates in any gas line triggers off an alarm as the same may indicate a leak.

On detection of any leak from any pipeline, the In-Charge Pipeline shall rush to the site along with team to:

- ❖ Assess the magnitude of incident

- ❖ Arrange the manpower, material (clamps, pipe, if required etc.) and equipments i.e. crane, excavator, hydraulic cutter, etc.) required for leakage arresting and pipeline maintenance
- ❖ Execution of repairing / maintenance job.

Other departments are also informed to provide necessary tools & equipment, materials & spares and trained man-power.

Meanwhile fire-fighting team and other emergency teams are kept on standby to take care of any fire or related eventuality.

As soon as any leakage is detected, the affected section is isolated, depressurised and clamped off. The affected section is positively isolated with blinds, depressurized, made hydrocarbon free before attempting any repair. Clamping is one of the remedial measures , to arrest leakage, in-situ. The effected vessels / pipelines emptied and made gas free. Necessary repair works are undertaken after ensuring that the atmosphere is free of suffocating and / or flammable gases.

In case of oil leakage / spill, the plant's oil spill contingency procedures are activated.

7.1.6 Central Disaster Control Room

Upon receiving information from any site regarding emergency, the person operating from the Disaster Control room will:

- Depute a person to rush to site and assess the situation.
- Inform CISF, fire, transport, safety, medical and concerned control room.
- Organise operating personnel and arrange for control over the situation.
- Keep the management informed about the gravity of the situation from time to time.

On receiving the call, the Disaster Control room would immediately direct the different supporting service agencies as enumerated below:

- ❑ Security and Administration services: responsible for safety of the yard against trespassers, saboteurs, any crowd, information to Government authorities and in the neighbourhood (if required), provision of transport facilities, telecommunication facilities and fire service facilities.
- ❑ Safety service: responsible for implementation of safety measures at work place and occupational safety.
- ❑ Medical service: responsible for providing medical care to the injured or the affected in an event of emergency.
- ❑ Stores: responsible for providing adequate number of tools, tackles and accessories for proper emergency control.
- ❑ Preservation of evidence and taking of photographs, if necessary, for future enquiries to determine the cause and taking further preventive actions.-
- ❑ Welfare: Provide food, clothes, shelter etc., as per requirements.
- ❑ Power and water supply: To ensure supply of fire fighting water requirement and provisions of power supply.

All emergency situations will be dealt in prompt manner as per the requirement. Trained personnel and rescue team are available to handle the various emergency situations. External regulatory authorities will also be taken in confidence to tackle the emergency situation.

The detailed On-site Emergency plan for the existing ONGC's Uran plant will be extended to incorporate emergency procedures for the proposed units.

7.1.7 OFF-SITE EMERGENCY PLANNING

Off-site emergency planning is normally under the jurisdiction of the district administration. The designated official of ONGC's Uran Plant is required to have co-ordination with the district administration for responsive action in off-site emergency planning.

7.1.8 FOOD POISONING

In case of food poisoning in any of the plant's canteens, the following will be done:

- ❑ Disaster Controller will inform the Medical Officer on duty at Plant Occupational Health Centre for immediate first aid.
- ❑ Medical Officer will contact the Chief Medical Officer at the plant's main hospital or super specialty hospitals located in Panvel, Vashi or even Mumbai city and seek their help, if necessary.
- ❑ Security (CISF) will help in evacuating the affected people, in co-ordination with the Medical Officer.

7.1.9 MUTUAL-AID SYSTEM

At times the possibility of a major emergency (a situation out of control of facility authorities) cannot be ruled out. In such a case, the plant authorities would declare it to be a major emergency and total control would be transferred to the district level office of contingency plan committee. Necessary help would also be sought from other sources having necessary infrastructure (such as Jawaharlal Nehru Port, Bharat Petroleum Corporation Ltd., Indian Navy etc.) for assistance in dealing with the disaster.

7.2 RAPID RISK ASSESSMENT STUDY

RRA study evaluates the consequences of potential failure scenarios, assess extent of damages, based on damage criteria's and suggest suitable measures for mitigating the Hazard. RRA involves identification of various potential hazards & credible failure scenarios for various units and other facilities including off-site storages & pumping, etc., based on their frequency of occurrence & resulting consequence. Basically two types of scenarios are identified spanning across various process facilities; Cases with high chance of occurrence but having low consequence, e.g., Instrument Tapping Failure (20 mm leak) and cases with low chance of occurrence but having high consequence, e.g., Large Hole on the outlet of Piping (50 mm leak). Effect zones for various outcomes of failure scenarios (Flash Fire, Jet Fire, Pool Fire, Blast overpressure, toxic release, etc.) are studied and identified in terms of distances on plot plan. Based on effect zones, measures for mitigation of the hazard / risk are suggested. Detailed Risk Analysis report is attached as **Annexure-V**.

7.2.1 MAJOR OBSERVATIONS & RECOMMENDATIONS

The summary of major observations & recommendations of RRA study for proposed GT-IV and ERTU is recorded below.

For GT-IV

Both high & low frequency flammable scenarios are modeled for hydrocarbon handling section of new proposed GT-IV Package.

- It is observed that the consequence outcomes (radiation & explosion) in the event of leak scenarios in KOD inlet section (5 mm, 10 mm, 20 mm & 50 mm), NG Steam heater outlet (10 mm & 20 mm), Fine Filter Separator Outlet line (10 mm & 20 mm) may affect & damage the nearby equipment's such as OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4 and condensate tank area.

Hence, it is recommended to locate the hydrocarbon & fire detectors at strategic locations near to these equipment's and provide adequate passive fire protection for the supports of affected equipment's / pipe racks. It is also recommended to ensure adequate fire-fighting provisions and remote isolation provisions for NG handling equipment / piping.

- Consequence outcomes (radiation & explosion) are also modelled for Fine Filter Separator Outlet line (10 mm & 20 mm) and HRSG-4 Inlet line (10 mm & 20 mm), near the GT-IV Gas metering station area and it is observed that Flash Fire & 12.5 Kw/m² Jet Fire radiation intensity may affect the nearby equipment's in GT-IV area.

It is recommended to select the electrical fittings in GT-IV package as per the Hazardous Area Classification study and install the hydrocarbon & fire detectors at strategic locations in GT-IV area. It is also recommended to provide adequate passive fire protection for the supports of equipment's / pipe racks in GT-IV area and ensure adequate fire-fighting provisions in GT-IV area.

It is also recommended to ensure proper electrical fittings selection & hydrocarbon gas evacuation / ventilation for the GT Hall (Indoor) in event of hydrocarbon leakage inside GT Hall (Indoor). SOP to address steps to be taken by operator in event of gas leakage inside GT Hall (Indoor). Adequate provisions for gas / fire detection & remote isolation for Natural Gas lines to be provided inside GT Hall (Indoor).

Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk.

a) Recommendations for Construction Safety during execution of the Project

- ✓ Adequate barricading of the new facilities to be done from existing running facilities during construction phase. Hydrocarbon / toxic detectors to be placed along the barricading suitably to detect any hydrocarbon / toxic gas in vicinity of construction area. Also, adequate firefighting & toxic gas handling arrangement are to be ensured in the construction area. Ensure training of persons associated with construction activities for response during fire & toxic gas release.
- ✓ Proper material movement path within the Complex shall be identified during the construction phase of the project.

- ✓ Detailed HSE Plan & HSE Philosophy to be developed by contractors during construction phase of the project, in line with client's safety requirements.

b) General Recommendations

- ✓ No new Operator Cabin / manned station to be located inside battery limits of new/ proposed GT-IV.
- ✓ Proper checking of contract people for smoking or inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition.
- ✓ Ensure vehicles entering the Complex are fitted with spark arrestors, as a mandatory item.
- ✓ In order to prevent secondary incident arising from any failure scenario, it is recommended that sprinklers and other protective devices are regularly checked to ensure they are functional.
- ✓ Mock drills to be organized at organization level to ensure preparation of the personnel's working in Complex for handling any hazardous situation.
- ✓ For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector.

c) Mitigating Measures

Mitigating measures are those measures in place to minimize the loss of containment event and, hazards arising out of Loss of containment. These include:

- ✓ Early detection of an undesirable event (HC leak, Toxic gas leak, Flame etc.) and development of subsequent quick isolation mechanism for major inventories.
- ✓ Measures for controlling / minimization of Ignition sources inside the complex.
- ✓ Active and Passive Fire Protection for critical equipment's and major structures
- ✓ Effective Emergency Response plans to be in place.

d) Ignition Control

- ✓ Ignition control will reduce the likelihood of fire events. This is the key for reducing the risk within facilities processing flammable materials. As part of mitigation measure it strongly recommended to consider minimization of the traffic movement within the Complex.

e) Escape Routes

- ✓ Ensure sufficient escape routes from the site are available to allow redundancy in escape from all areas.
- ✓ Ensure sufficient number of windssocks throughout the site to ensure visibility from all locations. This will enable people to escape upwind or crosswind from flammable / toxic releases.
- ✓ Provide sign boards marking emergency/safe roads to be taken during any exigencies.

f) Others

- ✓ Ensure removal of hammer blinds from the process facilities, if any.
- ✓ Closed sampling system to be considered for pressurized services like Natural Gas, LPG, Propylene etc.
- ✓ Recommended to use portable HC detector during sampling and maintenance etc.
- ✓ Provide breathing apparatus at strategic locations inside Complex

For ERTU

- Consequence outcomes (radiation, explosion → & Toxic dispersion) are modelled for Acid Gas line to Heat Recovery Unit (20 mm leak) and it is observed that LFL hazard zone may reach up to a distance of 2 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 59 m from leak source affecting the existing vacant Room and nearby approach road to Guest House.

It is recommended to install Toxic gas detectors with sirens at strategic locations at ERTU Package and traffic to be restricted on nearby approach road to Guest House in event of any leakage in ERTU Package. Also it is recommended to ensure that there is no permanent manned station / continuous human presence in the affected area of H₂S IDLH concentration of 100 ppm.

- Consequence modelling (radiation, explosion → & Toxic dispersion) is carried out for Acid Gas line to Heat Recovery Unit (50 mm leak) and it is observed that LFL hazard zone may reach up to a distance of 5 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 128 m from leak source affecting the existing vacant Room, nearby approach road to Guest House, GSU – I, II & III, C2-C3 Plant, C2-C3 Mechanical Store, SRR on northern side, GPG Store.

Hence, it is recommended to install Toxic gas detectors with sirens at strategic locations at ERTU Package. Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk. It is also recommended to ensure adequate fire-fighting provisions & Breathing Apparatus at ERTU Package.

CHAPTER – 8

PROJECT BENEFITS

8.0 BENEFITS OF THE PROJECT

Cogeneration Power Plant

The proposed co-generation plant shall use natural gas as the fuel for power generation. Natural gas is considered as a 'cleaner source' of thermal energy, having low carbon intensity as compared to coal because:

- ❖ Substantial amount of heat is generated from combustion of natural gas as compared to coal, forming water as combustion product, which is not harmful to environment.
- ❖ The atomization of fuel is better during combustion as compared to coal, as the gas molecules get rigorously mixed with air molecules providing oxygen for combustion. This
- ❖ helps in reduction of 'excess air quantity, in combustion and thereby increasing the 'flame temperature' and reducing flue gas losses.
- ❖ There are hardly any incombustibles (e.g. Ash) in natural gas as compared to coal. Hence combustion of natural gas does not lead to particulate matter generation.
- ❖ Moreover, the sulphur content of sweetened natural gas (in form of H₂S), which will be used in the proposed project, will be negligible. Hence hardly any Sulphur-dioxide will be generated.

The emission factors of Lignite and Natural Gas as per the International Panel for Climate Change (IPCC) are 0.1012 and 0.0561 (kilo tonnes CO₂/Trillion Joules) respectively. It is evident that coal is 80% higher CO₂ emitting source than natural gas for the generation of equivalent amount of energy. This gap further widens due to better efficiency factor of the proposed plant. The average efficiency of coal-fired conventional power plants is 30%, as against over 85% efficiency of the proposed gas based cogen power plant. This facilitates 55% less usage of input energy of natural gas as compared to input energy in conventional coal based power plant for the power production of equivalent amount. The plant shall operate at a PLF of 90 %. No transmission and distribution losses are considered since the project will cater to the additional power requirement of the plant and may export only a small surplus power to the nearby existing grid. Without the proposed project activity, the same energy load would have been drawn from the GRID to compensate the increased demand due to Additional Process units LPG-III, GSU-III CFUIII & CHU-IV which would have resulted in higher GRID connectivity. Thus the proposed project will help in reduction of cost and dependency on the grid.

This power plant operating on cleaner fuel like Natural Gas will lead to lower carbon dioxide (a Green House Gas) emissions for producing equivalent amount of power as compared to power plants operating on other fuels like coal/ oil/ naphtha. The project will also increase the installed electricity generating capacity of the plant making the plant self-sufficient. The project is a clean fuel power project, which will use natural gas as a fuel for power generation. Since the CO₂ emission due to combustion of natural gas is substantially less as compared to combustion of coal or naphtha, the project shall help in reducing GHG emissions.

Further since the project will be fuelled by natural gas; it will positively contribute towards the reduction in (demand) use of coal. The environmental problems associated with mining and land distance transportation of coal will be avoided.

The proposed project will generate employment, though only during the construction phase. CSR activities undertaken by ONGC shall improve the quality of the life of people in surrounding habitations.

Enhanced Reactive Thermal Oxidiser (ERTO) system

ONGC Uran Pant is processing 11.5 MMSCMD of Natural Gas from Mumbai Offshore and produces approximately 3800 TPD of Value Added Products (like LPG/C2C3 & Naphtha) from Natural Gas & Associated Condensate contributing to the national exchequer.

It has been observed that the average concentration of H₂S in natural gas feed to Uran plant is 118 ppm. For mitigation of H₂S, from Acid gas, Uran plant studied various technologies and finally selected ERTO process as per recommendation of NEERI, Nagpur as detailed below:

Elemental Sulphur recovery Unit (LOCAT or SULFEROX process)	Conversion of H₂S in acid gas into Sulphuric acid	Bio sulphur technology	Enhanced Reactive Thermal Oxidizer (ERTO)
Due to low sulphur loading in acid gas, the process of elemental sulphur recovery was not found technically feasible.	The conversion of H ₂ S into SO ₂ followed by conversion to H ₂ SO ₄ was also examined for its feasibility. But the process could not be implemented as H ₂ SO ₄ is highly corrosive and will render the environment hazardous for flora fauna and the human habitations surrounding the plant. Moreover, H ₂ SO ₄ vapours emanating from the liquid will be deteriorating for the extensive metal infrastructure of the plant. The exploitation of the end product, i.e. H ₂ SO ₄ is also not	Bio Sulphur technology involves conversion of H ₂ S into Bio Sulphur with the help of bacteria. It has been found that Bio Sulphur process operating on a very thin margin of operating conditions such as flow rate, temperature, pressure, etc. which leads to less flexibility in operation. Moreover, there is a limitation of space in the plant and bio-sulphur technology has high space requirement. Drying of bio-sulphur slurry and disposal of the same is also difficult.	Back ground: It has been observed that various technologies available in market are not viable for Uran plant, as sulphur load and other parameters are not matching the requirement of other processes. For seeking a suitable technology for H ₂ S mitigation for Uran plant, National Environmental Engineering and Research Institute (NEERI), Nagpur was engaged for feasibility study of H ₂ S mitigation. After detailed study NEERI has recommended Enhanced Reactive Thermal Oxidizer (ERTO) plant, which is

Elemental Sulphur recovery Unit (LOCAT or SULFEROX process)	Conversion of H2S in acid gas into Sulphuric acid	Bio sulphur technology	Enhanced Reactive Thermal Oxidizer (ERTO)
	viable because of its limiting concentration of 93% against the industrially utilizable concentration of 98%.		<p>most suitable for Uran plant and a proven technology for H2S mitigation.</p> <p>Process description:</p> <ul style="list-style-type: none"> ▶ Oxidization of hydrogen sulphide (H2S) from acid gas to SO2 with the help of EROTO. ▶ Conversion of SO2 to brine solution of Sodium Sulfite (Na2SO3) with the help of wet alkaline scrubber (Caustic solution, NaOH). ▶ Purifying the tail gas, for venting into the atmosphere (as per CPCB/MPCB norms). ▶ The liquid effluent (quantity <100 m3 per day), mainly brine solution of Sodium Sulfite (Na2SO3), shall be diluted with existing treated water (~ 3000m3 per day) from ETP and finally discharged into sea (complying MINAS standards of sulfite). Sodium Sulfite (Na2SO3) being white colored salt solution and all parameters like BOD, COD, TDS, TSS, PH shall be maintained as per MPCB norms, before discharging to sea, hence there shall be

Elemental Sulphur recovery Unit (LOCAT or SULFEROX process)	Conversion of H ₂ S in acid gas into Sulphuric acid	Bio sulphur technology	Enhanced Reactive Thermal Oxidizer (ERTO)
			<p>no adverse impact on Sea water.</p> <p>It has high scalability in plant operations and is designed to handle Acid gas flow from 0.4 MMSCMD to 0.133 MMSCMD. Space requirement is also less compared to other technologies. Uran Plant has acute space constraint.</p>

Note: Natural Gas Sweetening is not a common process and in India there are only two to three such plants using the Natural Gas Sweetening process. Hence, this makes it a niche area of technology. The selection of the H₂S handling process is unique to the feed to the Unit and varies from process to process. Many critical factors such as the concentration of H₂S in the acid gas, quantity of acid gas generated, the ease of handling the by-products of the Acid Gas removal process are crucial to selection of the process. The selection of ERTO was made after meticulous consideration of all such aspects, in consultation with NEERI.

SOCIO-ECONOMIC DEVELOPMENT

The proposed project would generate some direct and indirect employment opportunities during construction and operation phases, which will benefit the local people. Local skilled and unskilled labour will be required during construction and operation phase. Improvement in the overall socio-economic status of the vicinity of project area, in the thematic areas of health, education, livelihood and infrastructure is expected.

Social Development is an important component of any project taken by ONGC-Uran. An understanding of society is essential in helping people meet their social needs - food, water, shelter, health, knowledge, skills and physical and emotional security. How people define such needs and the priority and value give to them varies tremendously, not only from one country to another, but between different groups of people. A starting point for establishing appropriate and sustainable social services should be an analysis of how individuals, families and communities organise themselves in society to meet their needs as they define them. These facts have been already been noticed by ONGC-Uran and some are being focused while carrying out the development programmes in nearby areas. This project will also result in overall environmental quality improvement in this region.

CHAPTER – 9

DISCLOSURE OF CONSULTANTS

9.1 GENERAL INFORMATION

Name of Organization: Engineers India Limited

Address: Head - Environment, Water & Safety Division
Tower-I, Ground floor,
R&D centre, Engineers India Limited, Gurgaon
(On NH-8), Haryana-122001

Telephone Nos. : 0124-3802034

Email: rb.bhutda@eil.co.in

9.2 ESTABLISHMENT

Engineers India Limited (EIL) was established in 1965 to provide engineering and related services for Petroleum Refineries and other industrial projects. Over the years, it has diversified into and excelled in various fields. EIL has emerged as Asia's leading design, engineering and turnkey contracting company in Petroleum Refining, Petrochemicals, Pipelines, Onshore Oil & Gas, Mining & Metallurgy, Offshore Oil & Gas, Terminals & Storages and Infrastructure. EIL provides a wide range of design, engineering, procurement, construction supervision, commissioning assistance and project management as well as EPC services. It also provides specialist services such as heat & mass transfer equipment design, environment engineering, information technology, specialist materials and maintenance, plant operations & safety including HAZOPS & Risk Analysis, refinery optimization studies and yield & energy optimization studies.

Engineers India has earned recognition for jobs executed in India and several countries of West Asia, North Africa, Europe and South East Asia including Algeria, Bahrain, Kuwait, Korea, Malaysia, Norway, Qatar, Saudi Arabia, Sri Lanka, UAE and Vietnam. EIL is diversifying into the areas of Water & Waste Management, Nuclear Power, Thermal and Solar Power and City Gas Distribution.

EIL has its head office in New Delhi, regional engineering offices in Gurgaon, Chennai, Kolkata and Vadodara and a branch office in Mumbai. It has inspection offices at all major equipment manufacturing locations in India and a wholly owned subsidiary

Certification Engineers International Ltd. (CEIL) for undertaking independent certification & third party inspection assignments. Outside India, EIL has offices in Abu Dhabi (UAE), London, Milan and Shanghai and a wholly owned subsidiary, EIL Asia Pacific Sdn. Bhd. (EILAP) in Malaysia. EIL has also formed a joint venture Jabal EIL IOT with IOTL & Jabal Dhahran for tapping business opportunities in Saudi Arabia.

Backed by its unmatched experience, EIL enjoys a high professional standing in the market and is known as a versatile and competent engineering company that can be relied upon for meeting the clients' requirements. Quality Management System with respect to EIL's services conforms to ISO 9001:2008 The Design Offices are equipped with state-of-the-art computing systems, design tools and infrastructure.

9.3 EIL'S VISION

To be a world-class globally competitive EPC and total solutions Consultancy Organization.

9.4 EIL'S MISSION

- Achieve 'Customer delight' through innovative, cost effective and value added consulting and EPC services.
- To maximize creation of wealth, value and satisfaction for stakeholders with high standards of business ethics and aligned with national policies.

9.5 CORE VALUES OF EIL

- Benchmark to learn from superior role models.
- Nurture the essence of Customer Relationship and bonding.
- Foster Innovation with emphasis on value addition.
- Integrity and Trust as fundamental to functioning.
- Thrive upon constant Knowledge updation as a Learning organization.
- Passion in pursuit of excellence.
- Quality as a way of life.
- Collaboration in synergy through cross-functional Team efforts.
- Sense of ownership in what we do.

9.6 QUALITY POLICY OF EIL

- Enhance customer satisfaction through continuous improvement of our technologies, work processes, and systems and total compliance with established quality management system.
- Consistently improve the quality of products /services with active participation of committed and motivated employees and feedback from stakeholders.
- Provide added value to customers through timely and cost effective services/deliverables.
- Ensure total compliance with applicable health, safety and environment requirements during design and delivery of products to enrich quality of life.

9.7 HSE POLICY OF EIL

- Ensure compliance with requirements of health, safety and environment, during design and delivery of products/ services as per applicable National and International codes, standards, procedures, engineering practices, and statutory requirements including customer's requirements.
- Ensure safety and health of employees, personnel of clients and associates.
- Create awareness on health, safety and environment aspects for all employees and associates.

9.8 RISK MANAGEMENT POLICY OF EIL

- EIL is committed to effective management of risks across the organization by aligning its risk management strategy to its business objectives through
- Instituting a risk management structure for timely identification, assessment, mitigating, monitoring and reporting of risks.
- Risk management at EIL is the responsibility of every employee both individually as well as collectively.

The present EIA report has been prepared by EIL, an engineering and consultancy organization in the country. EIL has been preparing regularly EIA / EMP reports for different projects. The environmental Engineering Division of EIL has carried out more than 300 numbers of Environmental Impact Assessment projects.

9.9 SCOPE OF ACCREDITATION

National Accreditation Board for Education and Training (NABET) - under the Accreditation Scheme for EIA Consultant Organizations has accredited EIL as EIA consultant for 13 EIA Sectors (including 5 (c)- Petrochemical Complexes) , vide NABET notification dated 15/09/2019 and certification No.- NABET/EIA/1619/RA 0041 dated 22/03/2017. The list of sectors for which the accreditation has been accorded by NABET is given in **Figure 9.1**. The same can be referred from the NABET website “www.qcin.org/nabet/about.php”, by following the link - EIA Accreditation Scheme – Accreditation Register – Accredited Consultant.



Quality Council of India

National Accreditation Board for
Education & Training



Certificate of Accreditation

Engineers India Limited

Engineers India Limited Office Complex, Sec-16 (On NH-8), Gurgaon, Haryana-122001
are accredited under the QCI-NABET Accreditation Scheme for EIA Consultant Organizations
(Version 3) for preparing EIA/EMP reports in the following sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including opencast	1	1 (a) (i)	B
2	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
3	Thermal power plants	4	1 (d)	A
4	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
5	Petroleum refining industry	10	4 (a)	A
6	Chemical fertilizers	16	5 (a)	A
7	Petro-chemical complexes (Industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	18	5 (c)	A
8	Oil & gas transportation pipeline	27	6 (a)	A
9	Isolated storage & handling of Hazardous chemicals	28	6 (b)	B
10	Air ports	29	7 (a)	A
11	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
12	Ports, harbours, break waters and dredging	33	7 (e)	A
13	Townships and Area development projects	39	8 (b)	B

Note: Name of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated January 24, 2017 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/17/0283 dated 22 March 2017. The accreditation needs to be renewed before the expiry date by Engineers India Limited, following due process of assessment.


 CEO
NABET

Certificate No.
NABET/EIA/1619/ RA 0041

Issue Date
Mar. 22, 2017

Expiry Date
15.09.2019

For the updated List of Accredited Consultants please refer QCI-NABET website.

NABET is a member of International Accreditation Forum (IAF) and Pacific Accreditation Cooperation (PAC).

Fig. 9.1 : EIL Accreditation Certificate by NABET

ANNEXURE- I

APPROVED TERMS OF REFERENCE

No.J-11011/635/2008-IA.II(I)
Government of India
Minister of Environment, Forest and Climate Change
Impact Assessment Division

Indira Paryavaran Bhavan,
Vayu Wing, 3rd Floor, Aliganj,
Jor Bagh Road, New Delhi-110003
22 Mar 2018

To,

M/s ONGC
Corporate HSE, 8th Floor Core IV, SCOPE Minar, Delhi 10092 Delhi,
East-110092
Delhi

Tel.No.11-22406672; Email:sharma_js@ongc.co.in

Sir/Madam,

This has reference to the proposal submitted in the Ministry of Environment, Forest and Climate Change to prescribe the Terms of Reference (TOR) for undertaking detailed EIA study for the purpose of obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006. For this purpose, the proponent had submitted online information in the prescribed format (Form-1) along with a Pre-feasibility Report. The details of the proposal are given below:

- | | |
|---|--|
| 1. Proposal No.: | IA/MH/IND2/72647/2018 |
| 2. Name of the Proposal: | Expansion of onshore oil & gas processing plant at Uran by establishing Additional Cogeneration Unit GT-IV and Enhanced Reactive Thermal Oxidizer (ERTO) within the existing Uran Plant, Uran, Maharashtra |
| 3. Category of the Proposal: | Industrial Projects - 2 |
| 4. Project/Activity applied for: | 5(c) Petro-chemical complexes (industries based on processing of |
| 5. Date of submission for TOR: | 02 Feb 2018 |

In this regard, under the provisions of the EIA Notification 2006 as amended, the Standard TOR for the purpose of preparing environment impact assessment report and environment management plan for obtaining prior environment clearance is prescribed with public consultation as follows:

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

5(c): STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR PETRO-CHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TO AROMATICS) AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

A. STANDARD TERMS OF REFERENCE

1) Executive Summary

2) Introduction

- i. Details of the EIA Consultant including NABET accreditation
- ii. Information about the project proponent
- iii. Importance and benefits of the project

3) Project Description

- i. Cost of project and time of completion.
- ii. Products with capacities for the proposed project.
- iii. If expansion project, details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.
- iv. List of raw materials required and their source along with mode of transportation.
- v. Other chemicals and materials required with quantities and storage capacities
- vi. Details of Emission, effluents, hazardous waste generation and their management.
- vii. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)
- viii. Process description along with major equipments and machineries, process flow sheet (quantative) from raw material to products to be provided
- ix. Hazard identification and details of proposed safety systems.
- x. Expansion/modernization proposals:
 - a. Copy of all the Environmental Clearance(s) including Amendments thereto obtained for the project from MOEF/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment and Forests as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing (existing) operation of the project from SPCB shall be attached with the EIA-EMP report.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.

4) Site Details

- i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.
- ii. A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places)
- iii. Details w.r.t. option analysis for selection of site
- iv. Co-ordinates (lat-long) of all four corners of the site.
- v. Google map-Earth downloaded of the project site.
- vi. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.
- vii. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.
- viii. Landuse break-up of total land of the project site (identified and acquired), government/private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)
- ix. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area
- x. Geological features and Geo-hydrological status of the study area shall be included.
- xi. Details of Drainage of the project upto 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects)
- xii. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.
- xiii. R&R details in respect of land in line with state Government policy

5) Forest and wildlife related issues (if applicable):

- i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable)

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- ii. Landuse map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (*in case of projects involving forest land more than 40 ha*)
- iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.
- iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon
- v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area
- vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife.

6) Environmental Status

- i. Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.
- ii. AAQ data (except monsoon) at 8 locations for PM10, PM2.5, SO₂, NO_x, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.
- iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with - min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.
- iv. Surface water quality of nearby River (100m upstream and downstream of discharge point) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.
- v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC, if yes give details.
- vi. Ground water monitoring at minimum at 8 locations shall be included.
- vii. Noise levels monitoring at 8 locations within the study area.
- viii. Soil Characteristic as per CPCB guidelines.
- ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.
- x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.

- xi. Socio-economic status of the study area.

7) Impact and Environment Management Plan

- i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.
- ii. Water Quality modelling - in case of discharge in water body
- iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail-cum road transport or conveyor-cum-rail transport shall be examined.
- iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.
- v. Details of stack emission and action plan for control of emissions to meet standards.
- vi. Measures for fugitive emission control
- vii. Details of hazardous waste generation and their storage, utilization and management. Copies of MOU regarding utilization of solid and hazardous waste in cement plant shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.
- viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.
- ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.
- x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- xi. Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.
- xii. Action plan for post-project environmental monitoring shall be submitted.
- xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

8) Occupational health

- i. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers
- ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of above mentioned parameters as per age, sex, duration of exposure and department wise.
- iii. Details of existing Occupational & Safety Hazards. What are the exposure levels of hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,
- iv. Annual report of health status of workers with special reference to Occupational Health and Safety.

9) Corporate Environment Policy

- i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.
- ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.
- iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.
- iv. Does the company have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report

- 10)** Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- 11) Enterprise Social Commitment (ESC)
 - i. Adequate funds (at least 2.5 % of the project cost) shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be included. Socio-economic development activities need to be elaborated upon.
- 12) Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.
- 13) 'A tabular chart with index for point wise compliance of above TOR.

B. SPECIFIC TERMS OF REFERENCE FOR EIA STUDIES FOR PETRO-CHEMICAL COMPLEXES (INDUSTRIES BASED ON PROCESSING OF PETROLEUM FRACTIONS & NATURAL GAS AND/OR REFORMING TO AROMATICS)

1. Detailsonrequirementof raw material (naphtha/gasfeedstock),itssource of supply and stor a geat the plant.
2. Complete process flow diagram for all products with material balance.
3. Brief description of equipments for various process (cracker, separation, polymerization etc)
4. Details of proposed source-specific pollution control schemes and equipments to meet the national standards.
5. Detailson VOC emission control system from vents, stacks, fugitive emissions and flare management, etc.
6. Details on proposed LDAR protocol.
7. Ambientair quality should include hydrocarbon (methane and non methane), VOC and VCM (if applicable).
8. Action plan to meet the standard prescribed under EPA for petrochemical complex.
9. Risk Assessment & Disaster Management Plan
 - ? Identification of hazards
 - ? Consequence Analysis
 - ? Measures for mitigation of risk.

ANNEXURE- II

**COMPLIANCE TO ALL PREVIOUS
ECs**

Compliance report on various stipulations of environmental clearance for 5,70,000 MTPA Ethane- Propane Recovery Unit (EPRU) of ONGC Uran plant

Ref: - MoEF clearance vide No. J-11011/12/87-IA, Date 14.06.1990

Period: July-17 to December-2017

No	Stipulations	Compliance Status
I.	The project authority must strictly adhere to the stipulations made by the state Pollution control board.	The stipulations laid down by MPCB are being adhered strictly.
II.	The project authority must not seek expansion in the Uran terminal for any additional activities which involve Additional land or water. if any such proposals are envisaged details impact assessment report should be prepared covering 4 seasons data total land use Plan for consideration.	Additional Cogeneration Unit GT III commissioned in 2000. MOEF clearance obtained vide letter no. J-13011/18/95-1A-II dt.01.12.1995. Additional Processing Units (APU) are commissioned in Dec 2013. MOEF Clearance obtained Vide letter No. F. NO. J – 11011/635/2008 – IA – II(I) dated 29.04.2009.
III.	The project authority will not encroach on the beach for its own activity. The project authority must assist financially and otherwise for beautifying the beach and provide necessary access to tourist and visitor at the beach.	The plant authorities have not encroached on the beach for its own activity. Beach cleaning and planation are done.
IV.	The project authority will not construct further residential units/housing units/ guest houses at Uran. All the housing requirement should be made by ONGC at Panvel.	No housing colony has been made within the project premises.
V.	The project authority must abide by the provisions of the Maharashtra Regional & town planning act, 1966 for their Developmental activities at Uran.	Noted for compliance.
VI.	The capacity of the plant must be operated at the level of 5, 70,000 MTPA by keeping one Condensate Fractional unit (CFU) as stand by all the time.	Operating capacity of the C2-C3 plant remain at the level of 570,000 MTPA. One CFU plant is kept as stand by under normal feed conditions.
VII.	The project authority should not draw water in excess of 800 m ³ /hr from MIDC and should not draw any water from the Ground	The water drawl from MIDC is below the permissible limit and no ground water is being drawn.

	Water is resources. If additional quantity of water is required, the project authority should meet the requirement by recycling Only.	
VIII.	Sulphur recovery must be set up and action taken for the implementation must be furnished to the ministry within one month.	LOI placed on M/s Europem, Belgium for installation of Enhanced Reactive Thermal Oxidizer (ERTO) on 08.07.2016. Job is under execution & likely to be completed by October 2018.
IX.	The project authority should draw only 10.7 MMNCMD gas for the activities at Uran by revamping slug catcher already existing at Uran. No additional slug catcher should be installed at Uran terminal, since the existing slug catcher with revamping as envisaged will meet the requirements for the proposed expansion.	Implemented.
X.	Gaseous emissions from various process units should conform to the Standard prescribed by Govt. or the Central State Pollution Control Board. at no time the emission level should go beyond the stipulated standard. In the event of failure of any pollution control system adopted By the unit, the respective unit should be put out of operation immediately and should not restarted until the control systems are rectified to achieve the Desired efficiency.	Gaseous emission from various process units are being monitored and maintained conforming to the parameters/ standards stipulated by Maharashtra Pollution Control Board.
XI.	The project authority must recycle the Effluent / waste water to the Maximum Extent possible either for their plant Utilities or for afforestation.	Modernization of ETP plant is under implementation. In the modernization project of ETP there is a provision of construction of RO plant of capacity 200 M3/hr to use effluent water for recycling. The water shall be used internally.
XII.	The liquid effluent coming out of the Plant should be strictly conform to the MINAS before they are discharged into the deep sea.	The total liquid effluent coming out of the Plant is being treated in the Effluent Treatment Plant conforming to MPCB stipulated parameters in ETP before discharge to sea.
XIII	The project authority must set up eight air	Real Time Monitoring Stations (RTMs) for

	<p>quality monitoring stations at different location of the plant and in the nearby area in Consultation with the state pollution control board. The monitored data should be recorded and submitted to the state pollution control board once in three months and to this ministry once in six months.</p>	<p>continuous monitoring of ambient air are in place. The parameters are well within limits. The tender for air quality monitoring of Uran Plant has been awarded.</p>
XIV)	<p>The project authority must not change the height of the existing stacks without prior approval of the component authority. Continuous Stack Monitoring facility must be provided in the major stacks and the recorded data should be submitted to the State Pollution Control Board once in three months and to this ministry once in a six month.</p>	<p>There is no change in height of existing stacks. Continuous Stack Monitoring is done via Stack Monitoring Stations (SMSs) for all stacks and is connected to CPCB/MPCB servers online. The parameters are well within limits. Average stack monitoring data is placed opposite.</p>
XV)	<p>The project authority must submit disaster management plan to this ministry within Six month for review.</p>	<p>Detailed risk assessment of the plant including proposed facility has been carried out, accordingly Disaster Management Plan (DMP), has been updated and certified by Disaster Management Institute, Bhopal as per PNGRB guidelines/notification.</p>
XVI)	<p>The project authority must afforest 50 hectares of land with in project and the surrounding Area (excluding approach road plantation).</p> <p>The tree plantation must be at the rate of 1000 trees per acre.</p>	<p>Uran plant has total area of 112 hectares with good coverage of vegetation. ONGC Uran has developed green belt around plant boundaries. Recently Uran has planted 2234 plants in 7400 m² (approx.) area at expenditure of 37 lakhs and planned for another 2234 trees in about 5600 m². Also developed Green grass carpet along the roads with in the plant. Over and above two lakh trees planted on Dronagiri hill.</p>
XVI)	<p>The project authority must set up its own laboratory facility under the supervision of a senior technical personnel for collection & analysis of samples.</p>	<p>A full fledged Environmental / Chemistry lab. (Process and Product Control Laboratory) equipped with most modern equipment for analysis of water, crude oil, condensate, naphtha, LPG and other environmental parameters exist at Uran plant. This laboratory is in operation under the supervision of senior technical executive.</p>

XVI	A separate Environmental management cell with suitable qualified people to carry out various functions relating to environmental management should be set up under the control of a senior technical person who will directly report to the chief executive.	A separate Environmental Management cell with suitable qualified people exists at Uran plant. This section at Uran plant is controlled by senior technical executive
XIX	Adequate fund provision (capital and recurring expenditure) should be provided for implementation of all the conditions stipulated herein and funds so provided should not be diverted for any other purpose. The funds earmarked for this purpose should be communicated to this ministry within three months.	Annexure-1

Compliance report stipulations of environmental clearances accorded vide Letter No: J-13011/18/95-1A-II dated 01-12-95 MoEF for additional Co - generation facility at Uran

Period: - July-17 to December-2017

Sr. No.	Stipulations	Compliance Status
1.	All the conditions stipulated by the Maharashtra State Pollution Control Board shall be implemented effectively.	All stipulation of MPCB is being complied.
2.	The project shall be located within the existing complex of ONGC at Uran. No additional land shall be acquired for the purpose.	The project is located within the existing complex of ONGC at Uran. No additional land is acquired.
3.	Natural Gas is used as fuel.	For fuel, Natural Gas is used.
4..	A stack of height not less than 30 meter shall be provided for the proposed power plant.	Height of Stack is more than 30 meter.
5.	Provision shall be made for providing ports in the stack and monitoring of emissions from the stack shall be carried out regularly and records maintained.	The emission from the stack is being monitored through Continuous automatic stack monitoring system regularly and record is maintained.

6.	Adequate number of Air quality Monitoring station shall be set as in and around the complex and data on Air quality collected regularly. Periodic Report (three monthly) shall be submitted to this ministry	<p>Real Time Monitoring Stations (RTMs) are operational in Uran Plant. The parameters are well within limits. Available monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports. The tender for air quality monitoring of Uran plant is awarded.</p> <p>It is pertinent to mention that ONGC Uran plant is using gas based power generation which is a very clean fuel. The installed power generation is to meet the power requirement of the plant. Moreover Uran Plant is located away from Mumbai City and has very good dispersion efficiency due land and sea breeze and metrological conditions.</p>
7.	A detailed risk assessment for the Uran complex including the proposed facilities shall be carried out and report furnished to this ministry.	Detailed risk assessment of the plant including proposed facility has been carried out, accordingly disaster management plan has been updated and circulated.
8.	The liquid effluents shall be suitably treated to conform to the prescribed standard before discharge.	Liquid effluents are being treated at Effluent Treatment Plant for prescribed standard.
9.	Worker in the high Noise area shall be provided with ear protection devices.	<p>High Noise prone area is identified and operators have been provided with ear protection device. In the certain areas, sound proof cabin constructed for operators.</p> <p>Operator working in high noise area are rotated regularly besides personal protective equipment is provided</p>

10.	A green belt of adequate width and density (1500 – 2000 trees per acre) with suitably selected species shall be developed all around the power plant and in the Uran Complex as a whole.	Uran plant has total area of 112 hectares with good coverage of vegetation. ONGC Uran has developed green belt around plant boundaries. Recently Uran has planted 2234 plants in 7400 m ² (approx.) area at expenditure of 37 lakhs and planned for another 2234 trees in about 5600 m ² . Also developed Green grass carpet along the roads with in the plant. Over and above Two lakh trees planted on Dronagiri hill.
11.	An Environment Monitoring cell with suitably qualified staff shall be set up for implementation of the Environmental safe guards and their monitoring.	A separate Environmental Management cell with suitable qualified people exists at Uran plant. This section at Uran plant is controlled by senior technical executive
12.	Separate funds should be allocated for implementation of Environment protection measures along with item wise break up. This cost should be included as part of the project cost the funds earmarked for Environmental protection measured should not be diverted for other purpose.	Cost of equipment have been already covered in the project cost how ever fund for environment protection measure at Uran are being kept for dedicated utilization for environmental management which will not be diverted.
13.	The stipulated conditions will be monitored by our regional officer at Bhopal.	Noted.

Compliance report w.r.t. stipulated conditions of Environmental Clearance for Uran - Trombay – Jawahar Dweep 36” Oil pipeline Project

REF: MOEF Clearance vide letter No.. J-82/2004-IA, III Dated 20.12.2006

Period: - July-17 to December-2017

No	Stipulations	Compliance Status
A. Specific Conditions:-		
i)	The pipeline should not obstruct the free flow of the tidal waters.	Pipeline is underground both on land & sea area. So, no obstruction to free flow

		of tidal.
ii)	No fresh acquisition of the land should be undertaken except the leasing of land involved within JNPT area.	No fresh acquisition of the land is undertaken except the leasing of land involved within JNPT area.
iii)	The recommendations of the Risk analysis and DMP prepared by NEERI should be implemented.	Recommendations are implemented.
iv)	The mangroves necessarily to be cut for laying the pipeline should be re-afforested along the pipeline route after the pipeline is buried	Complied. Around 33500 mangroves and approx. 1500 plants are re-afforested in an area of around 3.46 hectare along the pipeline route.
v)	As submitted by ONGC, vide their letter No. ONGC / CHSE / JUT pipeline / 206.dated 6.12.2006 Rs.18.63 crore has been earmarked for EMP measures. Six monthly progress on implementation of EMP measures.	EMP measures are in place.
vi)	All the conditions stipulated by Maharashtra Pollution Control Board vide their Consent No. BO/RO(P&P)/CE/CC-613 dated 5.9.2006 should be effectively implemented.	All the stipulated conditions are effectively implemented.
vii)	It should be ensured that there is no displacement of people, houses or fishing activity as a result of the project.	No displacement of people / homes has taken place.
viii)	It should be ensured that due to the project, there is no adverse impact on the drainage of the area and recharge of ground water. No ground water should be tapped in the project area falling in Coastal Regulation Zone.	No adverse impact of drainage has taken place.
ix)	The camps of labour should be kept outside the Coastal Regulation Zone area, proper arrangement for cooking fuel shall be made for labour during construction phase so as to ensure that mangroves are not cut / destroyed for this purpose.	Project has been completed. No such activities are carried out.
x)	Regular drills should be conducted to check the effectiveness of the on-site Disaster Management Plan. The recommendation made in the Environmental Management Plan and Disaster Management Plan, as contained in the	Regular drills are being conducted as per the recommendations made in the EMP and DMP.

	Environmental Impact Assessment and Risk analysis reports of the project, should be effectively implemented.	
xi)	Markers should be installed at every 30 m to indicate the position of the line.	The pipeline has been laid in ROU Corridor width of 30 mts. which was accorded by GOI in 1978 through a gazette notification. Pipeline markers were installed at an interval of 250 mts, at every turning point and at each crossing in compliance OISD std. 141 clause 11.15 and also industry practice.
xii)	The smooth and safe operation of the system will be ensured by incorporating a computerized SCADA (Supervisory Control and Data acquisition) system. Any leakage in the pipeline shall be immediately detected by the Computer system and the product pumping shall be immediately cut-off.	ONGC have control rooms at both ends of the pipeline system. Pressure, flow, temperature & other process parameters are monitored on continuous basis using DCS system installed at Uran Plant & Trombay Terminal. In case of any substantial pressure drop which is an indication for leakage from the pipeline, immediately corrective measures like stoppage of pumping and isolation of affected section of the pipeline will be taken up
xiii)	Regular patrolling of the pipelines needs to be done. This will help in identifying any activity that have the potential to cause pipeline damage or to identify small leaks whose effects are too small to be detected by instrument.	Regular patrolling is carried out to ensure that pipeline is free from encroachment. Further adequate care is taken to prevent atmospheric corrosion by painting.
xiv)	There should be display boards at critical locations along the pipeline viz road/rail/river crossing giving emergency instructions as well as contract details. This will ensure prompt information regarding location of accident during any emergency.	The display boards are installed at critical locations like road / railway crossings. Intermediate valve platforms & all terminals. In addition to above, the pipeline markers being installed also reveal necessary information's in the display panel of PLMs.

xv)	During operation phase, proper precautions should be taken to avoid any oil spills and no oily wastes shall be discharged into the water bodies/mangrove areas.	The pipeline is a closed circuit system transporting oil from Uran to Trombay to Jawahar Deep. There is no oil spillage whatsoever. In view of the above, the discharge of oil in water bodies / mangrove area does not arise.
B. General Conditions:-		
i)	Construction of the proposed structures should be undertaken meticulously confirming to the existing central / local rules and regulations. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned State Government Department / Agencies.	Complied
ii)	The project authorities should take appropriate community development and welfare measures for the villagers in the vicinity of the project site, including drinking water facilities. A separate fund should be allocated for this purpose.	Community development & welfare measures are being taken by ONGC. Some examples are as under:- <ol style="list-style-type: none"> 1) Regular free medical camps. 2) Donation for nearby schools. 3) Help to down trodden through yearly components plans. 4) Skill development of villagers through NGOs. 5) Developing local entrepreneurs. 6) Drinking water to nearby Mosque & Pirwadi village.
iii)	To meet any emergency situation, appropriate fire fighting system should be installed. Appropriate arrangements for uninterrupted power supply to the environment protection equipment and continuous water supply for the fire fighting system should be made.	Firefighting System as per latest OISD guidelines is installed. Gas Turbine have been installed for providing power in addition to state electricity supply
iv)	A separate Environment Management Cell with suitable qualified staff to carry out the various environment related functions should be set up under the charge of a Senior Executive who will report directly to the Chief Executive of the Company.	A separate Environmental Management cell with suitable qualified people exists at Uran plant. This section at Uran plant is controlled by senior technical executive

v)	The funds earmarked for environment protection measures should be maintained in a separate account and there should be no diversion of these funds for any other purpose. A year wise expenditure on environmental safeguards should be reported to this Ministry's Regional Office at Bhopal.	Fund already allocated for environment protection over the operating life of the pipeline.
vi)	Full support should be extended to the officers of this Ministry's Regional Office at Bhopal and the officers of the Central and State Pollution Control Board by the project proponents during their inspection for monitoring purposes, by furnishing full details and action plan including the action taken reports in respect of mitigate measures and other environmental protection activities.	Full support is extended to the officers of Ministry's Regional Office.
vii)	In case of any deviation or alternation in the project including the implementing agency, a fresh reference should be made to this Ministry for modification in the clearance conditions or imposition of new one for ensuring environmental protection. The project proponents should be responsible for implementing the suggested safeguard measures.	No deviation or alternation has been made in the project.
viii)	The Ministry reserves the right to revoke this clearance, if any of the conditions stipulated are not complied with to the satisfaction to this Ministry.	Noted
ix)	The Ministry or any other competent authority may stipulate any other additional conditions subsequently, id deemed necessary, for environment protection, which shall be complied with.	Noted
x)	A copy of the clearance letter shall be marked to the concerned Panchayats / Local NGO, if any, from whom any suggestion / representation has been received while processing the proposal.	A copy of the clearance letter is already marked to the concerned Panchayats / Local NGO.

xi)	State Pollution Control Board / Committee should display a copy of the clearance letter at the District Industries Center and collector's Office / Tehsildar's Office for 30 days.	Compliance by MPCB, however ONGC has handed over copies to all concerned authorities for display.
xii)	The project proponent should advise at least in two local newspapers widely circulated in the region around the project one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of the clearance letters are available with the Maharashtra State Pollution Control Board and may also be seen at website of the Ministry of Environment and Forest at http://www.envfor.nic.in .	Implemented
xiii)	The project proponents should inform Regional office Bhopal as well as the Ministry, the date of financial closure and final approval of the project by concerned authorities and the date of start of work.	Implemented. As per latest guidelines, Maharashtra falls under the jurisdiction of Regional Office, Nagpur to which compliance reports are being submitted.
xiv)	The project proponent will obtain the Forest clearance for the land passing through the Reserved Forest area, if any.	No reserved forest area on land
xv)	So as to maintain ecological features and avoid damage to the ecosystem, movement of vehicles in the Inter Tidal Zone shall be restricted to the minimum.	Movement of vehicles in the Inter Tidal Zone is restricted to the minimum.
xvi)	Budgetary breakup for Environmental Management plan for the project to be mentioned.	Annexure-1

Compliance report w.r.t. stipulated conditions of Environmental Clearance for 20" Uran Trombay Gas Pipeline Project

REF: MOEF Clearance vide letter No. 11-61/2007-IA-III Dated 2.11.2007

Period: - July-17 to December-2017

No	Stipulations	Compliance Status
A. Specific Conditions:-		

i)	The project proponent should implement all the measures that have been suggested by them in the clarification letter no. Nil dated 17.10.2007 submitted to the Ministry.	Noted.
ii)	The pipeline should not obstruct the free flow of the tidal waters.	Pipeline is underground both through land & sea area. So, free flow of tidal water is there is in sea portion.
iii)	No fresh acquisition of the land should be undertaken. However, the leasing of land within JNPT area is permitted.	No fresh acquisition of the land is undertaken except the leasing of land involved within JNPT area.
iv)	The recommendations of the Risk analysis and DMP prepared by NEERI should be implemented.	Recommendation is implemented.
v)	The mangroves necessarily to be out for laying the pipeline should be re-afforested along the pipeline route after the pipeline is buried in the ratio of 1:3 in the 4 ha of land identified for afforestation	The mangroves are re-afforested along the pipeline route.
vi)	It should be ensured that there is no displacement of people, houses or fishing activity as a result of the project.	It is ensured that there is no displacement of people, houses or fishing activity as a result of the project.
vii)	It should be ensured that due to the project, there is no adverse impact on the drainage of the area and recharge of ground water. No ground water should be tapped in the project area falling in Coastal Regulation Zone.	It is ensured that due to the project, there is no adverse impact on the drainage of the area and recharge of ground water
viii)	The camps of labour should be kept outside the Coastal Regulation Zone area, proper arrangements for cooking fuel shall be made for labour during construction phase so as to ensure that mangroves are not cut / destroyed for this purpose.	Ensured
ix)	Regular drills should be conducted to check the effectiveness of the on-site Disaster Management Plan. The recommendation made in the Environmental Management Plan and Disaster Management Plan, as contained in the Environmental Impact Assessment and Risk analysis reports of the project, should be effectively implemented.	Regular drills are being conducted as per the recommendations made in the EMP and DMP.
x)	Markers should be installed at every 30 m to indicate the position of the line.	The pipeline has been laid in ROU Corridor width of 30 mts. which was

		<p>accorded by GOI in 1978 through a gazette notification.</p> <p>Pipeline markers were installed at an interval of 250 mts, at every turning point and at each crossing in compliance OISD std. 141 clause 11.15 and also industry practice.</p>
xi)	<p>The smooth and safe operation of the system will be ensured by incorporating a computerized SCADA (Supervisory Control and Data acquisition) system. Any leakage in the pipeline shall be immediately detected by the Computer system and the product pumping shall be immediately cut-off.</p>	<p>ONGC have control rooms at both ends of the pipeline system.</p> <p>Pressure, flow, temperature & other process parameters are monitored on continuous basis using DCS system installed at Uran Plant & Trombay Terminal.</p> <p>In case of any substantial pressure drop which is an indication for leakage from the pipeline, immediately corrective measures like stoppage of pumping and isolation of affected section of the pipeline will be taken up</p>
xii)	<p>Regular patrolling of the pipelines needs to be done. This will help in identifying any activity that have the potential to cause pipeline damage or to identify small leaks whose effects are too small to be detected by instrument.</p>	<p>Regular patrolling is carried out to ensure that pipeline is free from encroachment. Further adequate care is taken to prevent atmospheric corrosion by painting.</p>
xiii)	<p>There should be display boards at critical locations along the pipeline viz road/rail/river crossing giving emergency instructions as well as contract details. This will ensure prompt information regarding location of accident during the emergency.</p>	<p>The display boards are installed at critical locations like road / railway crossings. Intermediate valve platforms & all terminals.</p> <p>In addition to above, the pipeline markers being installed also reveal necessary information's in the display panel of PLMs</p>
xiv)	<p>During operation phase, proper precautions should be taken to avoid any oil spills and no oily wastes shall be discharged into the water bodies/mangrove areas.</p>	<p>The pipeline is a closed circuit system transporting gas from Uran to Trombay. There is no oil spillage whatsoever.</p> <p>In view of the above, the discharge of</p>

		oil in water bodies / mangrove area is not there.
B. General Conditions:-		
i)	Construction of the proposed structures should be undertaken meticulously confirming to the existing central / local rules and regulations. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned State Government Department / Agencies.	complied
ii)	The project authorities should take appropriate community development and welfare measures for the villagers in the vicinity of the project site, including drinking water facilities. A separate fund should be allocated for this purpose.	A separate fund is allocated for community development and welfare measures for the villagers in the vicinity of the project site including drinking water facilities.
iii)	To meet any emergency situation, appropriate fire fighting system should be installed. Appropriate arrangements for uninterrupted power supply to the environment protection equipment and continuous water supply for the fire fighting system should be made.	All terminal facilities are equipped with appropriate Fire Fighting System.
iv)	A separate Environment Management Cell with suitable qualified staff to carry out the various environment related functions should be set up under the charge of a Senior Executive who will report directly to the Chief Executive of the Company.	A separate Environmental Management cell with suitable qualified people exists at Uran plant. This section at Uran plant is controlled by senior technical executive
v)	The fund earmarked for environment protection measures should be maintained in a separate account and there should be no diversion of these funds for any other purpose. A year wise expenditure on environmental safeguards should be reported to this Ministry's Regional Office at Bhopal.	Fund already allocated for environment protection over the operating life of the pipeline.
vi)	Full support should be extended to the officers of this Ministry's Regional Office at Bhopal and the officers of the Central and State Pollution Control Board by the project proponents during their inspection for monitoring purposes, by furnishing full details and action plan including the action taken reports in respect of mitigate measures and other environmental	Full support is being extended to the officers of this Ministry's Regional Office at Bhopal the officers of the Central and State Pollution Control Board.

	protection activities.	
vii)	In case of any deviation or alternation in the project including the implementing agency, a fresh reference should be made to this Ministry for modification in the clearance conditions or imposition of new one for ensuring environmental protection. The project proponents should be responsible for implementing the suggested safeguard measures.	No deviation in the project.
viii)	The Ministry reserves the right to revoke this clearance, if any of the conditions stipulated are not complied with to the satisfaction to this Ministry.	Noted
ix)	The Ministry or any other competent authority may stipulate any other additional conditions subsequently, if deemed necessary, for environment protection, which shall be complied with.	Noted & ensured
x)	A copy of the clearance letter shall be marked to the concerned Panchayats / Local NGO, if any, from whom any suggestion / representation has been received while processing the proposal.	A copy of the clearance letter is already marked to the concerned Panchayats / Local NGO.
xi)	State Pollution Control Board / Committee should display a copy of the clearance letter at the District Industries Center and collector's Office / Tehsildar's Office for 30 days.	Compliance by MPCB, however ONGC have handed over copies to all concerned authorities.
xii)	The project proponent should advise at least in two local newspapers widely circulated in the region around the project one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of the clearance letters are available with the Maharashtra State Pollution Control Board and may also be seen at website of the Ministry of Environment and Forest at http://www.envfor.nic.in .	It was advertised in Indian Express, Mumbai and Loksatta, Mumbai.
xiii)	The project proponents should inform Regional office Bhopal as well as the Ministry, the date of financial closure and final approval of the project by concerned authorities and the date of start of work.	Implemented
xiv)	The project proponent will obtain the Forest clearance for the land passing through the Reserved Forest area,	No reserved forest area on land.

	if any.	
xv)	So as to maintain ecological features and avoid damage to the ecosystem, movement of vehicles in the Inter Tidal Zone shall be restricted to the minimum.	Movement of vehicles in the Inter Tidal Zone is restricted to the minimum
xvi)	Budgetary breakup for Environment Management plan for the project to be mentioned.	Annexure-1

Compliance report w.r.t. stipulated conditions of Environmental Clearance for Additional Process Facilities & Debutanisation Projects

REF: MOEF Clearance vide letter No. F.NO. J-11011/635/2008-IA-II(I) Dated 29.04.2009

Corrigendum: F.NO. J-11011/635/2008-IA-II(I) Dated 20.09.2010

Period: - July-17 to December-2017

A.SPECIFIC CONDITIONS

No	Stipulations	Compliance Status
I.	M/s ONGC Limited, Debutanisation Project at ONGC Uran Complex in Maharashtra shall comply with new standards /norms for Oil Drilling and Gas Extraction Industry notified under the Environment (Protection) Rules, 1986 vide GSR 176 (E) dated April 1996	Additional Process Units have been commissioned on 14.12.2013. Standard is complied
II.	The process emissions (SO ₂ , NO _x , HC, VOCs and Benzene) from various units shall conform to the standards prescribed by the Maharashtra State Pollution Control Board from time to time, the emission levels shall not go beyond the stipulated standards. In the event of failure of pollution control system(s) adopted by the unit shall be immediately put out of operation and shall not be restarted until the desired efficiency has been achieved.	It is pertinent to mention that all our operations are closed systems and there is an almost negligible fugitive emission in our operations. The ambient air meets NAAQS. VOC control from ETP has been given prime importance in modernization of ETP plant in order to reduce the pollution in the environment.
III.	Ambient air quality monitoring stations (SPM, SO ₂ , NO _x , H ₂ S, Mercaptan, NMHC and Benzene) shall be setup in the complex in consultation with SPCB., based on the occurrence of maximum ground level concentration and down wind direction of wind, The monitoring net work must be decided based on modeling exercise to present short term GLCs continuous on-line stack monitoring	Online Ambient air quality monitoring station is in place for monitoring of SPM, SO ₂ , NO _x , H ₂ S, etc. All our operations are closed system; there is very negligible fugitive emission is observed.

	equipment shall be installed for measurement of SO ₂ , NO _x , CO and O ₂ . Low NO _x burners shall be installed with online analyzers.	
IV.	Monitoring of fugitive emission shall be carried out as per the guidelines of CPCB by fugitive emission detectors and reports shall be submitted to the Ministry's regional office at Bhopal. For control of fugitive emission all unsaturated hydrocarbon will be routed to the flare system and the flare system shall be designed for smoke less burning.	All our operation is closed system; there is very negligible fugitive emission inside the plant. Uran plant has conducted a study on fugitive emissions and used Infrared cameras to detect fugitive emissions.
V.	Fugitive emission of HC from product storage tank yards etc. must be regularly monitored. Sensors for detecting HC leakage shall also be provided at strategic locations. The company shall use low sulphur fuel to maintain SO ₂ emission. Sulphur recovery units shall be installed for control of H ₂ S, emission. Leak detection and repair programme shall be implemented to control HC/VOC emissions. Work zone monitoring shall be carried out near the storage tanks besides monitoring of HC/VOC in the work zone.	Fugitive emission of HC from product storage tank yards etc. will be monitored regularly after the commissioning of facility. ERTO(Enhanced Reactive Thermal Oxidizer) facility for mitigation of H ₂ S is awarded to M/s Europem Belgium. & Expected completion in October 2018.
VI.	The waste water shall be treated in the waste water treatment plant and the treated effluent shall meet the prescribed standards. Efforts shall be made to recycle the treated effluent to achieve zero discharge. The company shall obtain prior permission for discharge if additional treated waste water in the sea from the concerned authority. The copy of the permission letter shall be submitted to Ministry's regional office at Bhopal.	The waste water is treated in the existing waste water treatment plant and the treated effluent meets the prescribed standards. An RO plant of capacity of 200 m ³ with facility to recycle and reuse the treated effluent is also envisaged under the scheme of ETP modernization.
VII.	The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of Hazardous Wastes (Management, Handling and Trans Boundary Movement) Rules, 1989/ 2003/2008 wherever applicable. Authorization from the state Pollution Control Board must be obtained for collections / treatment/ storage /disposal of hazardous wastes.	Consent to Establish/Operate has been obtained from MPCB. Authorization from the state Pollution Control Board is available for disposal of hazardous wastes.
VIII.	The company shall strictly follow all the recommendation mentioned in the chapter on Corporate Responsibility for Environment Protection (CREP)	Pollution control measures are provided for Environment Protection
IX.	The company shall take necessary measures to prevent fire	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	hazards in place. Flare tip of flare system has been replaced to meet the requirement. There is no proposal for Ground flaring. knockout drums exist.
X.	To prevent fire and explosion at Oil and Gas facility, potential ignition source shall be kept to a minimum and adequate separation distance between potential ignition source and flammable material shall be in place.	Being ensured through Hot Work Permit system (OISD-STD-105).
XI.	Occupational health surveillance of worker shall be done on a regular basis and records maintained as per Factory Act	Occupational health surveillance of worker is being done on regular basis.
XII.	Greenbelt shall be developed to mitigate the effect of fugitive emission all around the plant in a minimum 33% plant area in consultation with DFO as per CPCB guidelines.	Greenbelt has been developed as under: Uran plant has total area of 112 hectares with good coverage of vegetation. ONGC Uran has developed green belt around plant boundaries. Recently Uran has planted 2234 plants in 7400 m ² (approx.) area at expenditure of 37 lakhs and planned for another 2234 trees in about 5600 m ² . Also developed Green grass carpet along the roads with in the plant. Over and above Two lakh trees planted on adjacent Dronagiri hill.
XIII.	Provisions shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	Uran Plant being a most sensitive location from security point of view. No housing facilities of construction labour within the site.
XIV.	Data on ambient air quality stack emission and fugitive emissions shall be uploaded on the company's website and also regularly submitted on line to Ministry's regional office at Bhopal, Maharashtra Pollution Control Board and Central Pollution Control Board as well as hard copy once in six months. Data SPM, SO ₂ and NO _X shall also be displayed prominently outside the premises at the	Monitoring data is being displayed near main gate of the plant for the general public via an electronic display. Monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports

	appropriate place for the general public.	
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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 statutory body.	Uran Plant adheres to stipulations made by MPCB.
II.	No further expansion or modifications in the project shall be carried without prior approval of the Ministry of Environment and Forest. In case of deviations or alternation in the project proposal from those submitted to the Ministry for clearance, a fresh reference shall be made to the Ministry.	In case of deviations or alteration in the project fresh proposal is submitted.
III.	At no time, the emissions shall go beyond the prescribed standards. In the event of failure of any pollution control system, the respective facilities 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.	At no time, the emissions shall go beyond the prescribed standards. Adequate height of stack attached to DG sets is in place.
IV.	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.	Waste water is properly collected and treated in existing system conforming to the standards.
V.	The overall noise levels in and around the premises shall be limited within the prescribed standards (75dBA) 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 1989viz 75 dBA (9day time) and 70 dBA (night time).	Provision for sound barriers/acoustic enclosures on equipment and subsequent monitoring are practiced. Hearing protection measures are in place.
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 Rules 1989 as amended in 2000 for handling of hazardous chemical etc. Necessary approval from Chief Controller of Explosive must be obtained before commission of the expansion project, if required. Requisite Onsite and	Approval for storage import of Hazardous Chemical from Petroleum and Explosives Safety Organization (PESO) exists. Requisite Onsite and Offsite Disaster Management Plans are in place.

	Offsite Disaster Management Plans will be prepared and implemented.	
II.	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 neither provided should nor be diverted for any other purpose.	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 is provided. Funds are kept for the water cess payment, wastewater analysis, Hazardous waste disposal, Consent renewal and RTM & SMS preventive maintenance.
III.	The company shall develop rain water harvesting structures to harvest the run off water for recharge of ground water.	Uran plant has installed rain water harvesting system as a step towards its commitment for water conservation and greener and cleaner environment. Around 1000 m ³ water can be harvested daily-
IX.	The stipulated conditions will be monitored by the concerned Regional Office of this Ministry / Central Pollution Control Board / State Pollution Control Board. A six monthly compliance report and the monitored data should be submitted to them regularly. It will also be displayed on the web site of the company.	Monitoring data is being displayed near main gate of the plant for the general public via a electronic display. Monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports
X.	The project proponent should inform the public that the project has been accorded environment clearance by the Ministry and copies of the clearance letters are available with the State Pollution Control Board / Committee and may also be seen at web site of the Ministry of Environment and Forest at http://www.envfor.nic.in . This should be advertise within seven days from the date of issue of clearance letter at least two local news papers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and the copy of the same should be forwarded to the concerned regional office of this Ministry.	The publication has been done in two news papers i.e. Asian Age & Loksatta on 02.06.09
XI.	A separate environment management cell with full fledged laboratory facilities to carry out various	A separate Environmental Management cell with suitable

	management and monitoring function shall be setup under the control of a senior executive.	qualified people exists at Uran plant. This section at Uran plant is controlled by senior technical executive
XII.	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 concern authorities and the date of start of the project.	The project commissioned on 14.12.2013

Annexure- 1

Status of Fund on environment management at Uran Plant

SN	Description	Rupees in Lakhs
1	Implementation of online Effluent Monitoring System	16.79 x 0.5
2	Real time monitoring & Stack Monitoring Station	37.5
3	Hazardous waste disposal	161
4	ETP	11891 (for modernization of ETP to be done in a phase wise manner)
5	ERTO(Enhanced Reactive Thermal Oxidizer) for abatement of H ₂ s	4950

MAHARASHTRA POLLUTION CONTROL BOARD

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/4037124/4035273
Fax : 24044532/4024068 /4023516
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Visit At : <http://mpcb.gov.in>



Kalpataru Point, 3rd & 4th floor, Sion- Matunga
Scheme Road No. 8, Opp. Cine Planet Cinema, Near
Sion Circle, Sion (E),
Mumbai - 400 022

Consent order No :- Formate1.0/ BO/CAC-Cell/ UAN No 11474/1st CAC - 1709000522
Date- 14/09/2017

To,
Oil and Natural Gas Corporation Ltd,
Dronagiri, Uran, Dist-Raigad

Subject: Renewal of consent to operate under RED category.

Ref : 1. Earlier Consent granted vide no. Formate1.0/BO/CAC-Cell No NM-5084-14/14th CAC-9776 dated 21.10.2014.
2. Your application approved in CAC meeting held on 17.04.2017

Your application: 11474

Dated:08.08.2016

For: Renewal of consent to operate

under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization under Rule 5 of the Hazardous & Other Wastes (M & T) Rules 2016 is considered and the consent is hereby granted subject to the following terms and conditions and as detailed in the schedule I, II, III & IV annexed to this order:

1. The consent is granted for a period from 01.09.2016 to 31.08.2021.
2. The actual capital investment of the industry is Rs.2399.86 Crs. (As per C.A. Certificate submitted by industry).
3. The Consent is valid for the manufacture of -

Sr. No.	Product / By-Product Name	Maximum Quantity
1	Operation of Uran Plant with Additional Processing Unit	a) Crude Oil 20 MMTPA b) Natural Gas 16.00 MMSM3/DAY c) LPG 0.625 MMTPA d) Naptha 0.330 MMTPA e) C2-C3 0.625 MMTPA f) Electricity generation 59.6 MW

4. Conditions under Water (P&CP), 1974 Act for discharge of effluent:

Sr. no.	Description	Permitted quantity of discharge (CMD)	Standards to be achieved	Disposal
1.	Trade effluent	9000	As per Schedule -I	Through closed pipeline into sea.
2.	Domestic effluent	60	As per Schedule -I	Septic Tank

5. Conditions under Air (P & CP) Act, 1981 for air emissions:

Sr. no.	Description of stack / source	Number of Stack	Standards to be achieved
1.	Gas Heater (LPG-I)	1	As per Schedule -II
2.	Gas Heater (LPG-II)	1	As per Schedule -II
3.	Gas Heater (LPG-III)	1	As per Schedule -II
4.	HRSG-I (GT-1)	1	As per Schedule -II
5.	HRSG-II (GT-2)	1	As per Schedule -II
6.	HRSG-III (GT-3)	1	As per Schedule -II
7.	Thermax Boiler(Old)	1	As per Schedule -II
8.	Elevated Flare (Old)	1	As per Schedule -II
9.	Elevated Flare (New)	1	As per Schedule -II
10.	New Boiler Thermax Boiler (New)	1	As per Schedule -II
11.	Heater	1	As per Schedule -II
12.	DG Set (06 Nos)	6	As per Schedule -II

6. Conditions about Non Hazardous Wastes:

Sr. no.	Type Of Waste	Quantity & UoM	Treatment	Disposal
1	Kitchen waste	50kg/day	---	Through Local body
2	Paper waste	20 kg/day	----	Sale to authorized party

7. Conditions under Hazardous & Other Waste (M & T) Rules, 2016 for treatment and disposal of hazardous waste:

Sr. No.	Type Of Waste	Category	Quantity	UOM	Treatment	Disposal
1	Filter candle removed from CFU I & II, LPG I & II, S/c ph-II can contain pyrophoric substance	4.4 (Sch-I)	30	MT/Y	---	CHWTSDF
2	Sludge from Waste Water treatment	4.5 (Sch-I)	7000	MT/Y	---	CHWTSDF/ Bioremediation

3	Glass Wool	B2020	350	MT/Y		CHWTSDF
4	Poly Urethane Foam	B-18 (Sch-II)	60	MT/Y	---	CHWTSDF
5	Spent carbon / spent charcoal	34.3 (Sch-I)	80	MT/Y	---	CHWTSDF
7	Electrical Waste	A - 6 (Sch-II)	10	MT/Y	---	As per MPCB guidelines
8	Spent Catalyst & Molecular sieves	1.7	150	MT/Y	---	CHWTSDF
9	Polypropylene Biotower packing media	1.7	150	MT/Y	---	CHWTSDF
10	Spent resin	34.2	10	MT/Y	---	CHWTSDF
11	AFFF	B-24 (Sch-II)	40	MT/Y	---	CHWTSDF
12	Sludge from storage tank	3.3 (Sch-I)	1500	MT/Y	---	CHWTSDF/ Bioremediation
13	Batteries (Lead acid & Ni - Cd)	A4,B-6 (Sch-II)	2	MT/Y	---	CHWTSDF
14	Electronic Waste		10	MT/Y	---	As per MPCB guidelines
15	Filters & Filter material which have organic liquids in them arising from purification of organic compounds	35.1(Sch-I)	10	MT/Y	---	CHWTSDF

8. The Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.
9. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government authorities.
10. Industry shall provide modular STP within a period of 3 months and submit BG of Rs 10 lakh towards the compliance of the same.
11. Industry shall submit the undertaking stating that they have not increased the production quantity due to increased CI of Rs 154.84 crs.

For and on behalf of the
Maharashtra Pollution Control Board

(Dr. P. Anbalagan, IAS)
Member Secretary

Received Consent fee of -

Sr. No.	Amount(Rs.)	DD. No.	Date	Drawn On
1	The balance fees of Rs 13,11,838/- as per the previous consent no Formate1.0/BO/CAC-Cell No NM-5084-14/14th CAC-9776 dated			

	21.10.2014 shall be considered at the time of this renewal.			
2	22996442	0182586	28.07.2016	State Bank Of India

The remaining balance fees of Rs 184828/- shall be considered at the time of next renewal of consent.

Copy to:

1. Regional Officer - Navi Mumbai and Sub-Regional Officer-Taloja MPCB, They are directed to ensure the compliance of the consent conditions. You are directed to forfeit BG of Rs 2.5 lakh out of BG of Rs 5 lakh for exceeding JVS results collected on 09.06.2016 & 07.07.2016 and obtain top-up of Rs 5 lakh to make total BG of Rs 7.5 lakh for O & M of Pollution Control System. Also forfeit BG of 5 lakh obtained towards non installation of STP within stipulated time period and obtain top-up BG of Rs 10 lakh towards provision of modular STP within 3 months
2. Chief Accounts Officer, MPCB, Mumbai.
3. CC/CAC desk- for record & website updation purposes.

[Handwritten Signature]

Maharashtra Pollution Control Board

Schedule-I

Terms & conditions for compliance of Water Pollution Control:

1) A] As per your application, you have provided the Effluent Treatment Plant (ETP) with the design capacity of 9000 CMD.

B] The Applicant shall operate the effluent treatment plant (ETP) to treat the trade effluent so as to achieve the following standards prescribed by the Board or under EP Act, 1986 and Rules made there under from time to time, whichever is stringent.

Sr No.	Parameters	Standards prescribed by Board (If any)
		Limiting Concentration in mg/l, except for pH
01	pH	5.5-9.0
02	Oil & Grease	10
03	BOD (3 days 27°C)	30
04	Chromium as Cr Hexavalent Total	0.1
05	Copper as Cu	0.05
06	Suspended Solids	100
07	Cyanide as CN	0.0005
08	Fluoride	1.5
09	Lead as Pb	0.05
10	Mercury	0.01
11	Zinc	5
12	Nickel as Ni	0.1

C) The treated effluent shall be discharge to the Sea through well designed marine outfall.

2) A.] As per your consent application, you have provided the septic tanks and soak pits.

B] The Applicant shall operate the sewage treatment system to treat the sewage so as to achieve the following standards/ prescribed under EP Act, 1986 and Rules made there under from time to time, whichever is stringent.

- (1) Suspended Solids. Not to exceed 100 mg/l.
(2) BOD 3 days 27°C. Not to exceed 100 mg/l.

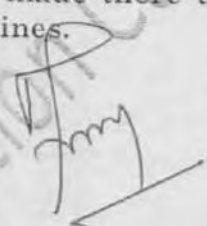
C] The treated sewage shall be soaked in a soak pit, which shall be got cleaned periodically.

3) The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification thereof & the system for the disposal of sewage or trade effluent or in connection with the grant of any consent conditions. The Applicant shall obtain prior consent of the Board to take steps to establish the unit or establish any treatment and disposal system or/and extension or addition thereto.

- 4) The industry shall ensure replacement of pollution control system or its parts after expiry of its expected life as defined by manufacturer so as to ensure the compliance of standards and safety of the operation thereof.
- 5) The Applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 and as amended, by installing water meters, filing water cess returns in Form-I and other provisions as contained in the said act.

Sr. no.	Purpose for water consumed	Water consumption quantity (CMD)
1.	Industrial Cooling, spraying in mine pits or boiler feed	16100
2.	Domestic purpose	100
3.	Processing whereby water gets polluted & pollutants are easily biodegradable	300
4.	Processing whereby water gets polluted & pollutants are not easily biodegradable and are toxic	0

- 6) The Applicant shall provide Specific Water Pollution control system as per the conditions of EP Act,1986 and rule made there under from time to time/ Environmental Clearance / CREP guidelines.



Schedule-II

Terms & conditions for compliance of Air Pollution Control:

1. As per your application, you have provided the Air pollution control (APC) system and also erected following stack (s) and to observe the following fuel pattern-

Sr. No.	Stack Attached To	APC System	Height in Mtrs.	Type of Fuel	Quantity & UoM	S %	SO ₂ Kg/Day
1	Gas Heater (LPG-I)	Stack	41.5	Natural Gas	Total Quantity 25405 kg/hr	Nil	50 kg/day
2	Gas Heater (LPG-II)		41.5				
3	Gas Heater (LPG-III)		32.5				
4	HRSG-I (GT-1)		18				
5	HRSG-II (GT-2)		18				
6	HRSG-III (GT-3)		30				
7	Thermax Boiler (Old)		30.00				
8	Elevated Flare (Old)		80.00				
9	Elevated Flare (New)		90.00				
11	Thermax Boiler (New)		35.00				
13	DG Set (06 nos)		30.00	Diesel	(300 ltr/day) used as power backup		

2. The Applicant shall provide Specific Air Pollution control equipments as per the conditions of EP Act, 1986 and rule made there under from time to time / Environmental Clearance / CREP guidelines.
3. The applicant shall operate and maintain above mentioned air pollution control system, so as to achieve the level of pollutants to the following standards:

Particulate matter	Not to exceed	150 mg/Nm ³ .
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Emission standards for VOC-HAPs from process vents:

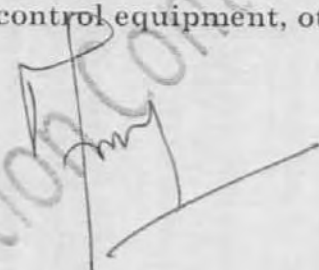
Sr.No	Compounds	Maximum emission limit (mg/Nm ³)
1	(Toluene Di-isocyanate), TDI, Methylenediphenyl Di-isocyanate (MDI)	0.1
2	Benzene, Butadiene	5

3	EO, VCM, EDC, CAN, PO	20
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Standards for Emissions of VOC Pollutants:

Sr.No	Compounds	Maximum emission limit (mg/Nm ³), dry basis
1	MA, PA, Phenol	20
2	Ethyl benzene (EB), Styrene, Toulene, Xylene, Aromatics, EG, PG	100
3	Non-methane HC (Paraffin), Acetone, olefins	150

4. The Applicant shall obtain necessary prior permission for providing additional control equipment with necessary specifications and operation thereof or alteration or replacement well before its life come to an end or erection of new pollution control equipment.
5. The Board reserves its rights to vary all or any of the condition in the consent, if due to any technological improvement or otherwise such variation (including the change of any control equipment, other in whole or in part is necessary).



**Schedule-III
Details of Bank Guarantees**

History of BG

Sr. No.	Consent (C to E/O/R)	Amt of BG Forfeited	Purpose of BG
1	C to R	Rs 2.5 out of 5 lakhs	Towards exceeding JVS results of the sample collected on 09.06.2016 & 07.07.2016
2	C to R	Rs 5 lakhs	Towards non Installation of STP

Proposed BG

Sr. No.	Consent (C to E/O/R)	Amt of BG Imposed	Submissi on Period	Purpose of BG	Complian ce Period	Validity Date
1	C to R	Rs 7.5 lakh (2.5 lakh+ Topup Rs 5 lakh	Within 15 days from date of issue of consent	O & M of PCS	31.08.2021	31.12.2021
2	C to R	Rs 10 lakhs	Within 15 days from date of issue of consent	Installation of STP	30.11.2018	28.02.2018

Schedule-IV

General Conditions:

- 1) The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous waste to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.
- 2) Industry should monitor effluent quality, stack emissions and ambient air quality monthly/quarterly.
- 3) The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.
- 4) Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.
- 5) The applicant shall provide an alternate electric power source sufficient to operate all pollution control facilities installed to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms and conditions of this consent.
- 6) The firm shall submit to this office, the 30th day of September every year , the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as per the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.
- 7) The industry shall recycle/reprocess/reuse/recover Hazardous & Other Waste as per the provision contain in the Hazardous & Other Waste (M&T) Rules 2016, which can be recycled/processed/reused/recovered and only waste which has to be incinerated shall go to incineration and waste which can be used for land filling and cannot be recycled/reprocessed etc should go for that purpose, in order to reduce load on incineration and landfill site/environment.
- 8) The industry should comply with the Hazardous & Other Waste (M&T) Rules 2016 and submit the Annual Returns as per Rule 5(6) & 22(2) of Hazardous & Other Waste (M&T) Rules 2016 for the preceding year April to March in Form-IV by 30th June of every year.
- 9) An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.
- 10) **The applicant shall make an application for renewal of the consent at least 60 days before the date of the expiry of the consent.**
- 11) Industry shall strictly comply with the Water (P&CP) Act, 1974, Air (P&CP) Act, 1981 and Environmental Protection Act, 1986 and industry specific standard under EP Rules 1986 which are available on MPCB website(www.mpcb.gov.in).
- 12) The industry shall constitute an Environmental cell with qualified staff/personnel/agency to see the day to day compliance of consent condition towards Environment Protection.
- 13) Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of the collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes/sewers downstream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system.
- 14) Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

- 15) The applicant shall install a separate meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.
- 16) Conditions for D.G. Set
 - a) Noise from the D.G. Set should be controlled by providing an acoustic enclosure or by treating the room acoustically.
 - b) Industry should provide acoustic enclosure for control of noise. The acoustic enclosure/ acoustic treatment of the room should be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on higher side. A suitable exhaust muffler with insertion loss of 25 dB (A) shall also be provided. The measurement of insertion loss will be done at different points at 0.5 meters from acoustic enclosure/room and then average.
 - c) Industry should make efforts to bring down noise level due to DG set, outside industrial premises, within ambient noise requirements by proper siting and control measures.
 - d) Installation of DG Set must be strictly in compliance with recommendations of DG Set manufacturer.
 - e) A proper routine and preventive maintenance procedure for DG set should be set and followed in consultation with the DG manufacturer which would help to prevent noise levels of DG set from deteriorating with use.
 - f) D.G. Set shall be operated only in case of power failure.
 - g) The applicant should not cause any nuisance in the surrounding area due to operation of D.G. Set.
 - h) The applicant shall comply with the notification of MoEF dated 17.05.2002 regarding noise limit for generator sets run with diesel.
- 17) The industry should not cause any nuisance in surrounding area.
- 18) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB (A) during day time and 70 dB (A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.
- 19) The applicant shall maintain good housekeeping.
- 20) The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a statement on available open plot area, number of trees surviving as on 31st March of the year and number of trees planted by September end, with the Environment Statement.
- 21) The non-hazardous solid waste arising in the factory premises, sweepings, etc. be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal of solid waste.
- 22) The applicant shall not change or alter the quantity, quality, the rate of discharge, temperature or the mode of the effluent/emissions or hazardous wastes or control equipments provided for without previous written permission of the Board. The industry will not carry out any activity, for which this consent has not been granted/without prior consent of the Board.
- 23) The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises.
- 24) The industry shall submit official e-mail address and any change will be duly informed to the MPCB.
- 25) The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification dtd. 16.11.2009 as amended.
- 26) The applicant shall comply with the conditions stipulated in Environmental Clearance granted by MoEF/GoM vide No.
 - a) Environmental clearance for 5,70,000 MTPA Ethane- Propane Recovery Unit (EPRU) Ref: - MoEF clearance vide No. J-11011/12/85-LA, Date 14.06.1990

b) Environmental clearances accorded vide Letter No: J-13011/18/95-1A-II dated 01-12-95 MoEF for additional Co-generation facility at Uran

c) Environmental Clearance for Additional Process Facilities & Debutanisation Projects. Ref: MOEF Clearance vide letter No. F.NO. J-11011/635/2008-IA-II(I) Dated 29.04.2009

Corrigendum: F.NO. J-11011/635/2008-IA-II(I) Dated 20.09.2010
(in case of first consent to operate).

—0000—



Maharashtra Pollution Control Board

ANNEXURE- III

**CERTIFIED LETTER FROM MoEFCC
REGIONAL OFFICE ON PREVIOUS EC
COMPLIANCE**



भारत सरकार
GOVERNMENT OF INDIA
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
MINISTRY OF ENVIRONMENT, FORESTS &
CLIMATE CHANGE

Regional Office (WCZ)
Ground Floor, East Wing
New Secretariat Building
Civil Lines, Nagpur - 440001
E-mail: apccfcentral-ngp-mef@gov.in

F.No: 5-52/2010(ENV)/ 3200

Date:02/02/2018

To,
Scientist 'E'
Member Secretary
IA Division (Industry-II)
Ministry of Environment, Forest & Climate Change
Indira Paryavaran Bhawan,
Aliganj, Jorbagh Road,
New Delhi-110003

Sub: Issue of "Certified Compliance Report" for Environment Clearances issued by MoEFCC to ONGC Uran Plant.

Ref:

1. MoEF letter no. J-11011/12/87-IA dated 14.06.1990
2. MoEF letter no. J-13011/18/95-IA-II dated 01.12.1995
3. MoEF letter no. J-82/2004-IA-III dated 20.12.2006
4. MoEF letter no. 11-61/2007-IA-III dated 02.11.2007
5. MoEF letter no. J-11011/635/2008-IA-II(I) dated 29.04.2009
6. Regional Office (WCZ), MoEF&CC, Nagpur letter no. F. No. EC-5-52/2010(ENV)/692 dated 21/07/2016
7. ONGC Letter no. MR/URN/ES/GT4/91/EC/2015 dated 26.12.2017 received on 16.01.2018

Sir,

I am directed to invite your kind attention on the above subject and letters under reference. The project was monitored 19.05.2016 in response to request made by project proponent for the certified compliance report required for the expansion of power generation project. Monitoring report of the project submitted to Ministry vide this office letter dated 21.07.2016. PA submitted the action taken report against the non/partial compliances observed during site inspection. Observations on action taken report submitted by project proponent are as under:

Condition	Observation of Regional Office during site inspection	Information submitted by PA
I. Clearance no. J-11011/12/87-IA date 14.06.1990		
Non-compliance:		
Condition no. VIII: Sulphur recovery must be set-up and action taken for the	Sulphur recovery unit has not been installed.	LOI placed on M/s. Europem. Belgium on 08.07.2016 with a completion period of 15 months

implementation must be furnished to the ministry within one month.		from the date of LOI. Job is under execution.
Partial Compliance:		
Condition No. XI: The project authority must recycle the Effluent / wastewater to the Maximum Extent possible either for their plant Utilities or for afforestation.	Effluent is being treated in the existing ETP, the treated effluent quality is confirming to prescribed standards. However the recycling is not being carried out.	Modernisation of ETP plant is under execution. LOI placed on M/s Newton Engineering on 11.05.15 with as completion of 32 months from the date of LOI. In the modernisation project of ETP there is a provision of construction of RO plant of capacity 200 M ³ /hr to use effluent water for recycling. The water shall be used internally. Moreover Uran Plant will be constructing 10 MLD Desalination Plant in course of time which will make Uran plant self-sufficient and thus saving very precious resource of fresh water. The proposal has been forwarded by Maharashtra CRZ committee to MOEFCC for further environment clearance process. The EDC is September, 2018.
Condition No. XIII: The project authority must set up eight air quality monitoring stations at different locations of the plant in the nearby area in Consultation with the State Pollution Control Board. The monitored data should be recorded and submitted to the State Pollution Control Board once in three months and to this ministry once in six months.	Air quality monitoring data is not being submitted to regional office of the ministry	Four real time monitoring stations (RTMs) of are in operational Uran plant. The parameters are well within limits. Some analysers are under repair/ replacements and will be completed by June 2017. Available monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports. Average air quality data is placed opposite. The tender for air

		quality monitoring of Uran Plant is under process and will be awarded by November 2016.
<p>Condition No. XIV: The project authority must not change the height of the existing stacks without prior approval of the component authority. Continuous Stack Monitoring facility must be provided in the major stacks and the recorded data should be submitted to the State Pollution Control Board once in three months and to this ministry once in six months.</p>	<p>Stack emission monitoring data is not being submitted to Regional Office of the Ministry.</p>	<p>Data is made available to MPCB/CPCB servers online. Four stack Monitoring stations (STMs) are operational in Uran plant. The parameters are well within limits. Some of the analyses are under repair/replacements and will be completed by June 2017 Available Monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports. Average stack monitoring data is placed opposite.</p>
<p>Condition No. XVI: The project authority must afforest 50 hectares of land within project and the surrounding Area. (excluding approach road plantation). The tree plantation must be at the rate of 1000 trees per acre.</p>	<p>Green belt development is not as per the stipulation.</p>	<p>Uran plant has total area of 112 hectares with good coverage of vegetation. ONGC Uran has developed green belt around plant boundaries. Uran has planted 2234 plants in 7400 m² (approx.) area at expenditure of 37 lakhs and recently another 2234 trees in about 5600 m². Also developed Green grass carpet along the roads with in the plant. Over and about two lakh trees planted on Dronagiri hill.</p>

II. Clearance no. J-13011/18/95-IA-II dated 01.12.1995**Partial Compliance:**

Condition no. 6: Adequate number of Air Quality Monitoring station shall be set as in and around the complex and data on Air quality collected regularly. Periodic Report (three monthly) shall be submitted to this ministry.

Periodical air quality monitoring reports were not submitted to Ministry.

Four real time monitoring stations (RTMs) of are in operational Uran plant. The parameters are well within limits. Some analysers are under repair/ replacements and will be completed by June 2017. Available monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports. Average air quality data is placed opposite. The tender for air quality monitoring of Uran Plant is under process and will be awarded by November 2016.

Condition no. 10: A green belt of adequate width and density (1500-2000 trees per acre) with suitably selected species shall be developed all around the power plant and in the Uran Complex as a whole.

Green belt development is not as per the stipulation.

Uran plant has total area of 112 hectares with good coverage of vegetation. ONGC Uran has developed green belt around plant boundaries. Uran has planted 2234 plants in 7400 m² (approx.) area at expenditure of 37 lakhs and recently another 2234 trees in about 5600 m². Also developed Green grass carpet along the roads with in the plant. Over and about two lakh trees planted on Dronagiri hill.

III. Clearance no. J-82/2004-IA-III dated 20.12.2006**Partial Compliance:**

Specific Condition no. XI: Markers should be installed at every 30 m to indicate the position of the line.

Marking of pipe line has been carried out at 250 meters interval against the Stipulation of 30

The pipeline has been laid in ROU Corridor width 30mts. which was accorded by GOI in 1978 through a gazette

	meter interval.	notification. Pipeline markers were installed at an interval of 250mts. at every turning point and at each crossing in compliance OISD std. 141 clause 11.15 and also industry practice.
General Condition no. X: A copy of the clearance letter shall be marked to the concerned Panchayats / Local NGO, if any, from whom any suggestion / representation has been received while processing the proposal.	A copy of the clearance letter is already marked to the concerned Panchayats/ Local NGO. However documentary proof is not available.	The document is not traceable since it s 10 years old. However ONGC will keep documentary evidence in future as and when clearances are obtained.
IV. Clearance no. 11-61/2007-IA-III dated 02.11.2007		
Partial Compliance:		
Specific Condition no. X: Markers should be installed at every 30 m to indicate the position of the line.	Marking of pipe line has been carried out at 250 meters interval against the Stipulation of 30 meter interval.	The pipeline has been laid in ROU Corridor width 30mts. which was accorded by GOI in 1978 through a gazette notification. Pipeline markers were installed at an interval of 250mts. at every turning point and at each crossing in compliance OISD std. 141 clause 11.15 and also industry practice.
General Condition no. X: A copy of the clearance letter shall be marked to the concerned Panchayats / Local NGO, if any, from whom any suggestion / representation has been received while processing the proposal.	A copy of the clearance letter is already marked to the concerned Panchayats/ Local NGO. However documentary proof is not available.	The document is not traceable since it s 10 years old. However ONGC will keep documentary evidence in future as and when clearances are obtained.
IV. Clearance no. J-11011/635/2008-IA-II(I) dated 29.04.2009		
Partial Compliance:		
Specific Condition no. II: The Process emissions (SO ₂ , NO _x , HC, VOCs and Benzene)	VOCs and Benzene monitoring has not been carried out. PA	Modernisation of ETP plant is under execution. LOI placed on M/s Newton Engineering on

<p>from various units shall conform to the standards prescribed by the Maharashtra State Pollution Control Board from time to time, the emission levels shall not go beyond the stipulated standards. In the event of failure of pollution control system(S) adopted by the unit shall be immediately put out of operation and shall not be restarted until the desired efficiency has been achieved.</p>	<p>has been told to include VOC and Benzene in the monitoring parameters.</p>	<p>11.05.15 with as completion of 32 months from the date of LOI. In the modernisation of ETP plant emphasis on VOC control from ETP has been give prime importance. A VOC control unit (90% efficiency) which shall restrict emission of VOC in the atmosphere and also reduce the pollution in the environment. All our operation is closed system and there is an almost negligible fugitive emissions in our operations. Benzene analysis has been included in job of tender for air quality monitoring of Uran plant which is under process and will be awarded by Nov 2016 and subsequently submitted.</p>
<p><u>Specific Condition no. III:</u> Ambient air quality monitoring stations (SPM, SO₂, NO_x, H₂S, Mercaptan, NMHC and Benzene) shall be set up in the complex in consultation with SPCB., based on the occurrence of maximum ground level concentration and down wind direction of wind, The monitoring net work must be decided based on modeling exercise to present short term GLCs continuous on-line stack monitoring equipment shall be installed for measurement of SO₂, NO_x, CO and O₂. Low NOx burners shall be installed with online analyzers.</p>	<p>One online Ambient air quality monitoring station is commissioned for monitoring of SPM, SO₂, NO_x, H₂S. However Mercaptan, Benzene are not being monitored. PA has been told to include Mercaptan and Benzene in the monitoring parameters.</p>	<p>All our operation is closed system; there is negligible fugitive emissions of Mercaptan and Benzene. Mercaptan is only used for injection in LPG spheres. Benzene analysis has been included in job of tender for air quality monitoring of Uran plant which is under process. The analysis report of Mercaptan will be submitted by 30th December 2016.</p>
<p><u>Specific Condition no. IV:</u></p>	<p>Monitoring of fugitive</p>	<p>All our operation is closed</p>

<p>Monitoring of fugitive emissions shall be carried out as per the guidelines of CPCB by fugitive emissions detectors and reports shall be submitted to the Ministry's regional office at Bhopal. For control of fugitive emission all unsaturated hydrocarbon will be routed to the flare system and the flare system shall be designed for smoke less burning.</p>	<p>emission is being carried out as per the guidelines of CPCB. Reports were not submitted to the Regional Office of the Ministry.</p>	<p>system; there is negligible fugitive emissions inside the plant. Uran plant has conducted a study on fugitive emissions and used infrared cameras to detect fugitive emissions. It is pertinent to mention that Uran plant is located away from Mumbai City and has very good dispersion efficiency due land and sea breeze and metrological conditions.</p>
<p><u>Specific Condition no. VIII:</u> The company shall strictly follow all the recommendation mentioned in the chapter on Corporate Responsibility for Environment Protection (CREP).</p>	<p>Most of the recommendation made in the CREP for oil refinery are being complied with, however Sulphur Recovery Unit installation is in process.</p>	<p>LOI placed on M/s. Europem. Belgium on 08.07.2016 with a completion period of 15 months from the date of LOI. Job is under execution.</p>
<p><u>Specific Condition no. XII:</u> Green belt should be developed to mitigate the effects of fugitive emissions all around the plant in a minimum 33% plant area in consultation with DFO as per CPCB guidelines.</p>	<p>Greenbelt is not covering 33% of the plant Area.</p>	<p>Greenbelt has been developed as under: Uran plant has total area of 112 hectares with good coverage of vegetation. ONGC Uran has developed green belt around plant boundaries. Uran has planted 2234 plants in 7400 m² (approx.) area at expenditure of 37 lakhs and recently another 2234 trees in about 5600 m². Also developed Green grass carpet along the roads with in the plant. Over and about two lakh trees planted on Dronagiri hill.</p>
<p><u>Specific Condition no. XIV:</u> Data on ambient air quality stack emission and fugitive emissions shall be uploaded</p>	<p>PA Submitted that data on air quality and stack emissions was uploaded to ONGC</p>	<p>Monitoring data is being displayed near main gate of the plant for the general public via a electronic display. Data is made</p>

<p>on the company's website and also regularly submitted on line to Ministry's regional office at Bhopal and Central Pollution Control Board as well as hard copy once in six months. Data SPM, SO2 and NOx shall also be displayed prominently outside the premises at the appropriate place for the general public.</p>	<p>website. However the same was not found in the website. PA is submitting the six monthly compliance reports, however the ambient air and stack monitoring data was not submitted.</p>	<p>available to MPCB/CPCB servers online. Monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports and compliance report will be uploaded to the website.</p>
<p><u>General Condition no. IX:</u> The stipulated conditions will be monitored by the concerned Regional Office of this Ministry's / 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.</p>	<p>PA submitted the six monthly compliance report regularly to the Regional Office of the Ministry. However it was observed that six monthly compliance report and monitored data were not uploaded to the web site of the company.</p>	<p>Monitoring data is being displayed near main gate of the plant for the general public via a electronic display. Data is made available to MPCB/CPCB servers online. Monitoring data shall be submitted to Regional office of the ministry along with six monthly compliance reports and compliance report will be uploaded to the website.</p>
<p><u>General Condition no. X:</u> The Project Proponent should inform the public that the project has been accorded environment 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://envfor.nic.in. This should be advertise within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in</p>	<p>The publication has been done in two news papers i.e. Asian age & Loksatta on 02.06.09, however the clause of seven days was not followed.</p>	<p>Earlier EC notifications published in newspapers, but not within stipulated 7 days. In future shall be published within seven days as per stipulation.</p>

the region of which one shall be in the vernacular language of the locality concerned and a copy of the same shall be forwarded to the Regional office of this Ministry's.		
--	--	--

It is concluded that, PA has taken following steps based on the monitoring report issued by this office vide letter no. F. No. F. No. EC-5-52/2010(ENV)/692 dated 21/07/2016.

1. PA submitted that works pertaining to sulphur recovery and effluent recycling are in progress.
2. Air quality monitoring data is being submitted to Regional Office along with six monthly compliance reports
3. PA submitted that markers were installed as per Oil Industry Safety Directorate (OISD) guidelines
4. PA submitted that Benzene has been included in Air quality monitoring parameters
5. PA submitted that in future advertisement will be published as per the stipulation.

The compliance report is forwarded for further necessary action at the Ministry.

This issues with the approval of APCCF (Central), Regional Office, Nagpur.

A. Suresh Kumar
02/02/18
Suresh Kumar Adapa
Scientist 'D'

Encl: as above

Copy to:

1. ✓ M/s ONGC Limited, Uran Complex, Dronagiri Bhawan, ONGC, Distt Raigad - 400702, Maharashtra
2. Guard File

A. Suresh Kumar
02/02/18
Suresh Kumar Adapa
Scientist 'D'

ANNEXURE- IV

PLOT PLAN DRAWING OF GT-IV & ERTO UNIT



- NOTES :-**
- ALL DIMENSIONS, LEVELS & CO-ORDINATES ARE IN METRES, PIPE SIZES ARE IN INCHES.
 - FIRE WATER MAIN SHALL BE GENERALLY LAID ABOVE GROUND ON SLEEPERS EXCEPT FOR THE FOLLOWING AREAS WHERE THE SAME ARE TO BE LAID UNDER GROUND;
 - UNDER ALL THE EXISTING/PROPOSED ROADS/APPROACHES TO ALL FACILITIES.
 - IN PAVED AREAS IN RCC TRENCHES, WITH PRECAST COVER AND FILLED WITH SAND.
 - AT ANY OTHER PLACE TO AVOID MECHANICAL DAMAGE TO THE PIPE LINE.
 - ABOVE GROUND FIRE WATER MAINS SHALL BE LAID ON THE
 - RCC SLEEPERS (300 TO 500MM HIGH)
 - STRUCTURAL SUPPORTS/JUMP OVER (FPR>500MM HIGH AT STEEP GRADIENTS AND TO CROSS THE PIPING/OTHER FACILITIES).
 - DRAIN VALVES/PRESSURE RELIEF VALVES/VENTS, TESTING VALVES WHEREVER REQUIRED SHALL BE PROVIDED ON THE PIPES.
 - THE PIPES SHALL BE ENCASED IN RCC SLEEVES UNDER ROADS.
 - HOSE CABINET SHALL BE PROVIDED WITH EVERY ALTERNATE HYDRANT.
 - ALL HYDRANTS, MONITOR, HWRs, VALVES ETC. SHALL BE MADE ACCESSIBLE BY PROVIDING FOOTPATH/STEPS/CROSS OVERS/STEEL BRIDGE ETC. WHEREVER REQUIRED.
 - FIRE WATER PIPES LAID UNDERGROUND/IN TRENCHES SHALL BE PROVIDED WITH TAPE COATING AS PER SPECIFICATION NO-6-79-0011.
 - PIPING SPEC. OF FIRE WATER PIPE SHALL BE AS PER PIPING MATERIAL SPECIFICATION (PMS).
 - ALL FIRE FIGHTING EQUIPMENTS SHALL CONFIRM TO RELEVANT INDIAN, INTERNATIONAL STANDARDS & MANUFACTURED BY TAC/ISI APPROVED VENDORS.
 - FIRE WATER PIPES LAID UNDERGROUND/IN TRENCHES SHALL BE PROVIDED WITH SPACING OF HYDRANT/MONITORS SHALL BE ALTERNATIVELY PROVIDED AS PER FOLLOWING;
 - AROUND PROCESS UNITS, TANK FARMS & OTHER HAZARDOUS AREA-30M C/C
 - LEVELS OF PIPES SHALL BE GENERALLY AS FOLLOWS.
 - UNDER GROUND PIPES
 - UNDER ROADS : 1500 MM
 - OTHER AREAS : 1200 MM
 - ABOVE GROUND PIPES: GENERALLY 300MM TO 500MM ABOVE FGL.
 13. SLEEPERS/SUPPORTS SHALL BE PROVIDED AT MAXIMUM 6M. C/C
 14. PLEASE REFER FIRE WATER NETWORK LAYOUT FOR INDIVIDUAL AREAS, FOR LOCATION & NO. OF FIREHYDRANT / MONITOR FOR PROPER COVERAGE TO EXISTING & PROPOSED AREAS.

- LEGEND:-**
- FGL FINISHED GRADE/GROUND LEVEL
 - FFL FINISHED FLOOR LEVEL
 - RTL TOP OF ROAD LEVEL
 - SIDE SLOPE
 - BATTERY LIMIT
 - SWD STORM WATER DRAIN
 - DOUBLE HEADED HYDRANT
 - WATER CUM FOAM MONITOR
 - LRM
 - HWR
 - FW FIRE WATER LINE
 - GV GATE VALVE
 - HUME PIPE

ISSUE	REVISIONS	PPD.	CHK.	APPD.	DATE
0	ISSUED FOR APPROVAL	MMP	WVS/SP	AGV	26/09/12
1	REVISED AS MARKED & RE-ISSUED FOR PMC APPROVAL	KKP	WVS/SP	AGV	07/03/13
2	AS-BUILT	CRB	WVS/SP	AGV	28/07/14

DO NOT SCALE

OWNER :	OIL AND NATURAL GAS CORPORATION LTD. URAN.
OWNER PMC :	TRIUNE ENERGY SERVICES PVT.LTD. NEW DELHI.
LSTK CONTRACTOR :	TATA PROJECTS LIMITED MUMBAI. JOB NO:- TPL/OG/037.
DETAIL ENGINEERING CONSULTANT :	Mott MacDonald Pvt. Ltd. MUMBAI. JOB NO:- 301953

SITE :	URAN
FILE NAME :	FW-0037-47-PD-00-GA-0038-02
DRAWING TITLE :	OVERALL LAYOUT FOR FW NETWORK DRAWING.

SCALE :	DOCUMENT NUMBER :	SHT.	REV.
1:2000	FW-0G037-47-PD-00-GA-0038-02	1	2

ANNEXURE- V

RAPID RISK ANALYSIS REPORT

RAPID RISK ANALYSIS STUDY
OF
ADDITIONAL CO-GENERATION UNIT GT-IV
AT
ONGC URAN PLANT



OIL AND NATURAL GAS CORPORATION LTD.,
URAN

A	Dec 17 th 18	Issued for Comments	VI/ST	MKJ	RBB
Rev No	Date	Purpose	Prepared By	Reviewed By	Approved By

PREFACE

Engineers India Limited (EIL), New Delhi, has been entrusted by M/s BHEL, Hyderabad for Rapid Risk Analysis Study of Additional Co-Generation Unit GT-IV at ONGC Uran Plant at Uran in the state of Maharashtra, India.

In this perspective, Rapid Risk Analysis Study of the GT-IV proposed at ONGC Uran Plant is being carried out.

Rapid Risk Analysis study identifies the hazards associated with the facility, analyses the consequences, draws suitable conclusions and provides necessary recommendations to mitigate the hazard/ risk.

This Rapid Risk Analysis study is based on the information made available at the time of this study and EIL's own data source for similar plants. EIL has exercised all reasonable skill, care and diligence in carrying out the study. However, this report is not deemed to be any undertaking, warrantee or certificate.

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

Engineers India Limited (EIL), New Delhi, has been entrusted by M/s BHEL, Hyderabad for Rapid Risk Analysis Study of Additional Co-Generation Unit GT-IV at ONGC Uran Plant at Uran in the state of Maharashtra, India.

In this context, Rapid Risk Analysis Study of the GT-IV proposed at ONGC Uran Plant is being carried out.

1.2 APPROACH METHODOLOGY

RRA study evaluates the consequences of potential failure scenarios, assess extent of damages, based on damage criteria's and suggest suitable measures for mitigating the Hazard.

RRA involves identification of various potential hazards & credible failure scenarios for various units and other facilities including off-site storages & pumping, etc., based on their frequency of occurrence & resulting consequence. Basically two types of scenarios are identified spanning across various process facilities; Cases with high chance of occurrence but having low consequence, e.g., Instrument Tapping Failure (20 mm leak) and cases with low chance of occurrence but having high consequence, e.g., Large Hole on the outlet of Piping (50 mm leak). Effect zones for various outcomes of failure scenarios (Flash Fire, Jet Fire, Pool Fire, Blast overpressure, toxic release, etc.) are studied and identified in terms of distances on plot plan. Based on effect zones, measures for mitigation of the hazard / risk are suggested.

1.3 MAJOR OBSERVATIONS & RECOMMENDATIONS

The major credible failure scenarios are modeled in terms of hydrocarbon release rate, dispersion, flammability & toxic characteristics and detailed consequence analysis of the outcome is presented in the Rapid Risk Analysis (RRA) report. The summary of major observations & recommendations of RRA study for GT-IV are summarized below:

Both high & low frequency flammable scenarios are modeled for hydrocarbon handling section of new proposed GT-IV Package.

- It is observed that the consequence outcomes (radiation & explosion) in the event of leak scenarios in KOD inlet section (5 mm, 10 mm, 20 mm & 50 mm), NG Steam heater outlet (10 mm & 20 mm), Fine Filter Separator Outlet line (10 mm & 20 mm) may affect & damage the nearby equipment's such as OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4 and condensate tank area.

Hence, it is recommended to locate the hydrocarbon & fire detectors at strategic locations near to these equipment's and provide adequate passive fire protection for the supports of affected equipment's / pipe racks. It is also recommended to ensure adequate fire-fighting provisions and remote isolation provisions for NG handling equipment / piping.

- Consequence outcomes (radiation & explosion) are also modelled for Fine Filter Separator Outlet line (10 mm & 20 mm) and HRSG-4 Inlet line (10 mm & 20 mm), near the GT-IV Gas metering station area and it is observed that Flash Fire & 12.5 Kw/m² Jet Fire radiation intensity may affect the nearby equipment's in GT-IV area.

It is recommended to select the electrical fittings in GT-IV package as per the Hazardous Area Classification study and install the hydrocarbon & fire detectors at strategic locations in GT-IV area. It is also recommended to provide adequate passive fire protection for the supports of equipment's / pipe racks in GT-IV area and ensure adequate fire-fighting provisions in GT-IV area.

It is also recommended to ensure proper electrical fittings selection & hydrocarbon gas evacuation / ventilation for the GT Hall (Indoor) in event of hydrocarbon leakage inside GT Hall (Indoor). SOP to address steps to be taken by operator in event of gas leakage inside GT Hall (Indoor). Adequate provisions for gas / fire detection & remote isolation for Natural Gas lines to be provided inside GT Hall (Indoor).

Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk.

a) Recommendations for Construction Safety during execution of the Project

- ✓ *Adequate barricading of the new facilities to be done from existing running facilities during construction phase. Hydrocarbon / toxic detectors to be placed along the barricading suitably to detect any hydrocarbon / toxic gas in vicinity of construction area. Also, adequate firefighting & toxic gas handling arrangement are to be ensured in the construction area. Ensure training of persons associated with construction activities for response during fire & toxic gas release.*
- ✓ *Proper material movement path within the Complex shall be identified during the construction phase of the project.*
- ✓ *Detailed HSE Plan & HSE Philosophy to be developed by contractors during construction phase of the project, in line with client's safety requirements.*

b) General Recommendations

- ✓ *No new Operator Cabin / manned station to be located inside battery limits of new proposed GT-IV.*
- ✓ *Proper checking of contract people for smoking or inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition.*
- ✓ *Ensure vehicles entering the Complex are fitted with spark arrestors, as a mandatory item.*
- ✓ *In order to prevent secondary incident arising from any failure scenario, it is recommended that sprinklers and other protective devices are regularly checked to ensure they are functional.*

- ✓ *Mock drills to be organized at organization level to ensure preparation of the personnel's working in Complex for handling any hazardous situation.*
- ✓ *For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector.*

c) Mitigating Measures

Mitigating measures are those measures in place to minimize the loss of containment event and, hazards arising out of Loss of containment. These include:

- ✓ Early detection of an undesirable event (HC leak, Toxic gas leak, Flame etc.) and development of subsequent quick isolation mechanism for major inventories.
- ✓ Measures for controlling / minimization of Ignition sources inside the complex.
- ✓ Active and Passive Fire Protection for critical equipment's and major structures
- ✓ Effective Emergency Response plans to be in place

d) Ignition Control

- ✓ Ignition control will reduce the likelihood of fire events. This is the key for reducing the risk within facilities processing flammable materials. As part of mitigation measure it strongly recommended to consider minimization of the traffic movement within the Complex.

e) Escape Routes

- ✓ Ensure sufficient escape routes from the site are available to allow redundancy in escape from all areas.
- ✓ Ensure sufficient number of windsocks throughout the site to ensure visibility from all locations. This will enable people to escape upwind or crosswind from flammable / toxic releases.
- ✓ Provide sign boards marking emergency/safe roads to be taken during any exigencies.

f) Others

- ✓ Ensure removal of hammer blinds from the process facilities, if any.
- ✓ Closed sampling system to be considered for pressurized services like Natural Gas, LPG, Propylene etc.
- ✓ Recommended to use portable HC detector during sampling and maintenance etc.
- ✓ Provide breathing apparatus at strategic locations inside Complex.

2 INTRODUCTION

2.1 STUDY AIMS AND OBJECTIVE

The objectives of the Rapid Risk Analysis study are to identify and quantify all potential failure modes that may lead to hazardous consequences and extent. Typical hazardous consequences include fire, explosion and toxic releases.

The Rapid Risk analysis will also identify potential hazardous consequences having impacts on population and property in the vicinity of the facilities, and provides information necessary in developing strategies to prevent accidents and formulate the Disaster Management Plan.

The Rapid Risk Analysis includes the following steps:

- a) Identification of failure cases within the process and off-site facilities
- b) Evaluate process hazards emanating from the identified potential accident scenarios.
- c) Analyze the damage effects to surroundings due to such incidents.
- d) Suggest mitigating measures to reduce the hazard / risk.

The Risk analysis study has been carried out using the risk assessment software program 'PHASt ver. 7.21 developed by DNV Technica.

2.2 SCOPE OF WORK

The study addresses the hazards that can be realized due to operations associated with the new GT-IV proposed at ONGC Uran Plant.

3 SITE CONDITION

3.1 GENERAL

This chapter describes the location of Gas Processing Complex of ONGC and meteorological data, which have been used for the Rapid Risk Analysis study.

3.2 SITE, LOCATION AND VICINITY

Oil & Natural Gas Corporation (ONGC) presently operates a Gas Processing Complex at Uran, Maharashtra, India.

Figure 1: ONGC-Uran Site



3.3 METEOROLOGICAL CONDITIONS

The consequences of released toxic or flammable material are largely dependent on the prevailing weather conditions. For the assessment of major scenarios involving release of toxic or flammable materials, the most important meteorological parameters are those that affect the atmospheric dispersion of the escaping material. The crucial variables are wind direction, wind speed, atmospheric stability and temperature. Rainfall does not have any direct bearing on the results of the risk analysis; however, it can have beneficial effects by absorption / washout of released materials. Actual behavior of any release would largely depend on prevailing weather condition at the time of release.

For the Risk Analysis study, Meteorological data of Mumbai have been taken from the Climatological Tables of Observatories in India (1981-2010) published by Indian Meteorological Department, Pune.

Atmospheric Parameters

The Climatological data which have been used for the Risk Analysis study is summarized below:

Table 1: Atmospheric Parameter

Sl. No.	Parameter	Average Value Considered For Study
1.	Ambient Temperature (°C)	28
2.	Atmospheric Pressure (mm Hg)	760
3.	Relative Humidity (%)	75
4.	Solar Radiation flux (kW/m ²)	0.76

Wind Speed and Wind Direction

The average monthly wind speed varies between 1.41 to 3.38 m/s. For the purpose of present study the selected representative wind speeds are 1.5 m/s, 2 m/s and 3 m/s. These wind speeds have been selected to represent the entire range of wind speeds in the region.

Table 2: Average Mean Wind Speed (m/s)

Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1.55	1.8	1.97	2.16	2.55	3.02	3.38	3.05	1.91	1.47	1.44	1.41

Table 3: % Number of Days Wind From

	N	NE	E	SE	S	SW	W	NW	Calm
N	4	8	7	3	4	9	13	5	47
D	11	1	0	0	1	10	28	46	3

Weather Category

One of the most important characteristics of atmosphere is its stability. Stability of atmosphere is its tendency to resist vertical motion or to suppress existing turbulence. This tendency directly influences the ability of atmosphere to disperse pollutants emitted into it from the facilities. In most dispersion scenarios, the relevant atmospheric layer is that nearest to the ground, varying in thickness from a few meters to a few thousand meters. Turbulence induced by buoyancy forces in the atmosphere is closely related to the vertical temperature gradient.

Temperature normally decreases with increasing height in the atmosphere. The rate at which the temperature of air decreases with height is called Environmental Lapse Rate (ELR). It will vary from time to time and from place to place. The atmosphere is said to be stable, neutral or unstable

according to ELR is less than, equal to or greater than Dry Adiabatic Lapse Rate (DALR), which is a constant value of 0.98°C/100 meters.

Pasquill stability parameter, based on Pasquill – Gifford categorization, is such a meteorological parameter, which decreases the stability of atmosphere, i.e., the degree of convective turbulence. Pasquill has defined six stability classes ranging from 'A' (extremely unstable) to 'F' (stable). Wind speeds, intensity of solar radiation (daytime insolation) and nighttime sky cover have been identified as prime factors defining these stability categories. Below Table indicates the various Pasquill stability classes.

Table 4: Pasquill Stability Classes

Surface Wind Speed (meter/s)	Day time solar radiation			Night time cloud cover		
	Strong	Medium	Slight	Thin < 3/8	Medium 3/8	Overcast >4/5
< 2	A	A – B	B	-	-	D
2 – 3	A – B	B	C	E	F	D
3 – 5	B	B – C	C	D	E	D
5 – 6	C	C – D	D	D	D	D
> 6	C	D	D	D	D	D

Legend: A = Very unstable, B = Unstable, C = Moderately unstable, D = Neutral, E = Moderately stable, F = stable

When the atmosphere is unstable and wind speeds are moderate or high or gusty, rapid dispersion of pollutants will occur. Under these conditions, pollutant concentrations in air will be moderate or low and the material will be dispersed rapidly. When the atmosphere is stable and wind speed is low, dispersion of material will be limited and pollutant concentration in air will be high. In general worst dispersion conditions (i.e. contributing to greater hazard distances) occur during low wind speed and very stable weather conditions, such as that at 1F weather condition (i.e. 1 m/s wind speed and Pasquill Stability F).

Stability category for the present study is identified based on the cloud amount and wind speed. For risk analysis the representative average annual weather conditions are assessed based on the following:

Average Wind speed in order of 1-2 m/s would be experienced for 75% of time in a year and > 3 m/s would be experienced during rest of 25 % time. Based on weather analysis, predominant weather stability of "F", "C" & "D" is selected with wind speed 1.5, 2 m/s & 3 m/s for consequence analysis.

The consequence results are reported in tabular form for all the weather conditions and are represented graphically for worst weather condition.

Table 5: Weather Conditions

Wind Speed	Pasquill Stability
1.5	F
2	C
3	D

Note: For RRA Study Overall Plot Plan [BHEL Doc. No.: PY-LQ-0-M108-2001-01 Rev 01] has been used.

4 HAZARDS ASSOCIATED WITH THE FACILITIES

4.1 GENERAL

Gas Processing complex handles a number of hazardous materials like LPG, Natural Gas, Naphtha and other hydrocarbons which have a potential to cause fire and explosion hazards. The toxic chemicals like Hydrogen sulfide & Chlorine are also handled in the complex. This chapter describes in brief the hazards associated with these materials.

4.2 HAZARDS ASSOCIATED WITH FLAMMABLE MATERIALS

4.2.1 LIQUEFIED PETROLEUM GAS

LPG is a colorless liquefied gas that is heavier than air and may have a foul smelling odorant added to it. It is a flammable gas and may cause flash fire and delayed ignition.

LPG is incompatible to oxidizing and combustible materials. It is stable at normal temperatures and pressure. If it is released at temperatures higher than the normal boiling point it can flash significantly and would lead to high entrainment of gas phase in the liquid phase. High entrainment of gas phase in the liquid phase can lead to jet fires. On the other hand negligible flashing i.e. release of LPG at temperatures near boiling points would lead to formation of pools and then pool fire. LPG releases may also lead to explosion in case of delayed ignition.

Inhalation of LPG vapors by human beings in considerable concentration may affect the central nervous system and lead to depression. Inhalation of extremely high concentration of LPG may lead to death due to suffocation from lack of oxygen. Contact with liquefied LPG may cause frostbite. Refer to below table for properties of LPG.

Table 6: Hazardous Properties of LPG

Sl. No.	Properties	Values
1.	LFL (%v/v)	1.7
2.	UFL (%v/v)	9.0
3.	Auto ignition temperature (°C)	420-540
4.	Heat of combustion (Kcal/Kg)	10960
5.	Normal Boiling point (°C)	-20 to -27
6.	Flash point (°C)	- 60

4.2.2 NATURAL GAS

Natural gas can be used as fuel in many sectors as; transportation, industrial, agricultural, and a raw material for petrochemical industry. Natural gas is a hydrocarbon consisting mainly of methane, although it usually also contains a variable percentage of nitrogen, ethane, CO₂, H₂O, butane, propane, mercaptans and traces of heavier hydrocarbons. Methane can constitute up to 97% of natural gas. Its relative density makes it lighter than air, so that leaks or emissions quickly dissipate into the upper layers of the atmosphere, making it less likely to form explosive mixtures

in the air. Exposure to natural gas through gas leaks can be harmful. It may lead to explosions and pose serious health hazards that are sometimes even fatal. Small gas leaks accumulate over a period of time and add a significant amount of pollutants that stress the immune system and other bodily functions. One of the major health effects of natural gas leakage is asphyxiation. If a natural gas leak has occurred and is severe, oxygen can be reduced, causing dizziness, fatigue, nausea, headache, and irregular breathing." Gas leaks can cause serious harm to plants, thus affecting the environmental ecosystem as well.

Table 7: Hazardous Properties of Natural Gas

Sl. No.	Properties	Values
1.	LFL (%v/v)	5
2.	UFL (%v/v)	15
3.	Auto ignition temperature (°C)	537 - 580
4.	Heat of combustion (Kcal/Kg)	13000
5.	Normal Boiling point (°C)	-161.6
6.	Flash point (°C)	-188

4.3 HAZARDS ASSOCIATED WITH TOXIC MATERIALS

4.3.1 HYDROGEN SULPHIDE

Hydrogen sulfide is a known toxic gas and has harmful physiological effects. Accidental release of hydrocarbons containing hydrogen sulfide poses toxic hazards to exposed population. Refer to below table for hazardous properties of Hydrogen Sulphide.

Table 8: Toxic Effects of Hydrogen Sulphide

Sl. No.	Threshold Limits	Concentration (PPM)
1.	Odor threshold	0.0047
2.	Threshold Limit Value(TLV)	10
3.	Short Term Exposure Limit (STEL) (15 Minutes)	15
4.	Immediately Dangerous to Life and Health (IDLH) level (for 30 min exposure)	100

5 HAZARD IDENTIFICATION

5.1 GENERAL

A classical definition of hazard states that hazard is in fact the characteristic of system/plant/process that presents potential for an accident. Hence all the components of a system/plant/process need to be thoroughly examined in order to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

In Risk Analysis terminology a hazard is something with the potential to cause harm. Hence the Hazard Identification step is an exercise that seeks to identify what can go wrong at the major hazard installation or process in such a way that people may be harmed. The output of this step is a list of events that need to be passed on to later steps for further analysis.

The potential hazards posed by the facility were identified based on the past accidents, lessons learnt and a checklist. This list includes the following elements.

- 5 mm leak
- 10 mm leak
- 20 mm leak
- 50 mm leak

5.2 MODES OF FAILURE

There are various potential sources of large leakage, which may release hazardous chemicals and hydrocarbon materials into the atmosphere. These could be in form of gasket failure in flanged joints, bleeder valve left open inadvertently, an instrument tubing giving way, pump seal failure, guillotine failure of equipment/ pipeline or any other source of leakage. Operating experience can identify lots of these sources and their modes of failure. A list of general equipment and pipeline failure mechanisms is as follows:

Material/Construction Defects

- Incorrect selection or supply of materials of construction
- Incorrect use of design codes
- Weld failures
- Failure of inadequate pipeline supports

Pre-Operational Failures

- Failure induced during delivery at site
- Failure induced during installation
- Pressure and temperature effects
- Overpressure
- Temperature expansion/contraction (improper stress analysis and support design)
- Low temperature brittle fracture (if metallurgy is incorrect)
- Fatigue loading (cycling and mechanical vibration)

Corrosion Failures

- Internal corrosion (e.g. ingress of moisture)
- External corrosion
- Cladding/insulation failure (e.g. ingress of moisture)
- Cathodic protection failure, if provided

Failures due to Operational Errors

- Human error
- Failure to inspect regularly and identify any defects

External Impact Induced Failures

- Dropped objects
- Impact from transport such as construction traffic
- Vandalism
- Subsidence
- Strong winds

Failure due to Fire

- External fire impinging on pipeline or equipment
- Rapid vaporization of cold liquid in contact with hot surfaces

5.3 SELECTED FAILURE CASES

A list of selected failure cases was prepared based on process knowledge, engineering judgment, experience, past incidents associated with such facilities and considering the general mechanisms for loss of containment. A list of cases has been identified for the consequence analysis study based on the following.

- Cases with high chance of occurrence but having low consequence: Example of such failure cases includes 5 mm leak, 10 mm leak, 20 mm leak etc. The consequence results will provide enough data for planning routine safety exercises. This will emphasize the area where operator's vigilance is essential.
- Cases with low chance of occurrence but having high consequence (The example includes 50 mm leak, etc.)

This approach ensures at least one representative case of all possible types of accidental failure events, is considered for the consequence analysis. Moreover, the list below includes at least one accidental case comprising of release of different sorts of highly hazardous materials handled in the complex. Although the list does not give complete failure incidents considering all equipment's, units, but the consequence of a similar incident considered in the list below could be used to foresee the consequence of that particular accident.

For selected credible failure scenarios and likely consequences for GT-IV, refer Section-6.

6 CONSEQUENCE ANALYSIS

6.1 GENERAL

Consequence analysis involves the application of the mathematical, analytical and computer models for calculation of the effects and damages subsequent to a hydrocarbon / toxic release accident.

Computer models are used to predict the physical behavior of hazardous incidents. The model uses below mentioned techniques to assess the consequences of identified scenarios:

- Modeling of discharge rates when holes develop in process equipment/pipe work
- Modeling of the size & shape of the flammable/toxic gas clouds from releases in the atmosphere
- Modeling of the flame and radiation field of the releases that are ignited and burn as jet fire, pool fire and flash fire
- Modeling of the explosion fields of releases which are ignited away from the point of release

The different consequences (Flash fire, pool fire, jet fire and Explosion effects) of loss of containment accidents depend on the sequence of events & properties of material released leading to the either toxic vapor dispersion, fire or explosion or both.

6.2 CONSEQUENCE ANALYSIS MODELLING

6.2.1 DISCHARGE RATE

The initial rate of release through a leak depends mainly on the pressure inside the equipment, size of the hole and phase of the release (liquid, gas or two-phase). The release rate decreases with time as the equipment depressurizes. This reduction depends mainly on the inventory and the action taken to isolate the leak and blow-down the equipment.

6.2.2 DISPERSION

Releases of gas into the open air form clouds whose dispersion is governed by the wind, by turbulence around the site, the density of the gas and initial momentum of the release. In case of flammable materials the sizes of these gas clouds above their Lower Flammable Limit (LFL) are important in determining whether the release will ignite. In this study, the results of dispersion modeling for flammable materials are presented LFL quantity.

6.2.3 FLASH FIRE

A flash fire occurs when a cloud of vapors/gas burns without generating any significant overpressure. The cloud is typically ignited on its edge, remote from- the leak source. The combustion zone moves through the cloud away from the ignition point. The duration of the flash fire is relatively short but it may stabilize as a continuous jet fire from the leak source. For flash fires, an approximate estimate for the extent of the total effect zone is the area over which the cloud is above the LFL.

6.2.4 JET FIRE

Jet fires are burning jets of gas or atomized liquid whose shape is dominated by the momentum of the release. The jet flame stabilizes on or close to the point of release and continues until the release is stopped. Jet fire can be realized, if the leakage is immediately ignited. The effect of jet flame impingement is severe as it may cut through equipment, pipeline or structure. The damage effect of thermal radiation is depended on both the level of thermal radiation and duration of exposure.

6.2.5 POOL FIRE

A cylindrical shape of the pool fire is presumed. Pool-fire calculations are then carried out as part of an accidental scenario, e.g. in case a hydrocarbon liquid leak from a vessel leads to the formation of an ignitable liquid pool. First no ignition is assumed, and pool evaporation and dispersion calculations are being carried out. Subsequently late pool fires (ignition following spreading of liquid pool) are considered. If the release is banded, the diameter is given by the size of the bund. If there is no bund, then the diameter is that which corresponds with a minimum pool thickness, set by the type of surface on which the pool is spreading.

6.2.6 VAPOR CLOUD EXPLOSION

A vapor cloud explosion (VCE) occurs if a cloud of flammable gas burns sufficiently quickly to generate high overpressures (i.e. pressures in excess of ambient). The overpressure resulting from an explosion of hydrocarbon gases is estimated considering the explosive mass available to be the mass of hydrocarbon vapor between its lower and upper explosive limits.

6.3 SIZE AND DURATION OF RELEASE

Leak size considered for selected failure cases are listed below¹. Leak sizes considered here are representative hole sizes in the upstream / downstream circuit of particular equipment for which failure scenario has been considered.

Table 9: Size of Release

Failure Description	Leak Size
Pump seal failure	5 mm hole size
Flange gasket failure	10 mm hole size
Instrument tapping failure	20 mm hole size
Large Hole in the Piping	50 mm, complete rupture of 2" drain line at the Process vessel / piping outlet

The discharge duration is taken as 10 minutes for continuous release scenarios as it is considered that it would take plant personnel about 10 minutes to detect and isolate the leak².

¹ Refer to Guideline for Quantitative Risk assessment 'Purple Book'.

² Release duration is based on Chemical Process Quantitative Risk Analysis, CCPS.

6.4 DAMAGE CRITERIA

In order to appreciate the damage effect produced by various scenarios, physiological/physical effects of the blast wave, thermal radiation or toxic vapor dispersion are discussed.

6.4.1 LFL OR FLASH FIRE

Hydrocarbon vapor released accidentally will spread out in the direction of wind. If a source of ignition finds an ignition source before being dispersed below lower flammability limit (LFL), a flash fire is likely to occur and the flame will travel back to the source of leak. Any person caught in the flash fire is likely to suffer fatal burn injury. Therefore, in consequence analysis, the distance of LFL value is usually taken to indicate the area, which may be affected by the flash fire.

Flash fire (LFL) events are considered to cause direct harm to the population present within the flammability range of the cloud. Fire escalation from flash fire such that process or storage equipment or building may be affected is considered unlikely.

6.4.2 THERMAL HAZARD DUE TO POOL FIRE, JET FIRE AND FIRE BALL

Thermal radiation due to pool fire, jet fire or fire ball may cause various degrees of burn on human body and process equipment. The damage effect due to thermal radiation intensity is tabulated below.

Table 10: Damage Due to Incident Thermal Radiation Intensity

Incident Radiation Intensity (Kw/M ²)	Type of Damage
37.5	Sufficient to cause damage to process equipment
32.0	Maximum flux level for thermally protected tanks containing flammable liquid
12.5	Minimum energy required for piloted ignition of wood, melting of plastic tubing etc.
8.0	Maximum heat flux for un-insulated tanks
4.0	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds. However blistering of skin (1 st degree burns) is likely.

The hazard distances to the 37.5 kW/m², 12.5 kW/m², and 4 kW/m² radiation levels, selected based on their effect on population, buildings and equipment were modeled using PHAST.

6.4.3 VAPOR CLOUD EXPLOSION

In the event of explosion taking place within the plant, the resultant blast wave will have damaging effects on equipment, structures, building and piping falling within the overpressure distances of the blast. Tanks, buildings, structures etc. can only tolerate low level of overpressure. Human body, by comparison, can withstand higher overpressure. But injury or fatality can be inflicted by collapse of building of structures. The damage effect of blast overpressure is tabulated below.

Table 11: Damage Effects of Blast Overpressure

Blast Overpressure (PSI)	Damage Level
5.0	Major structure damage
3.0	Oil storage tank failure
2.5	Eardrum rupture
2.0	Repairable damage, pressure vessels remain intact, light structures collapse
1.0	Window pane breakage possible, causing some injuries

The hazard distances to the 5 psi, 3 psi and 2 psi overpressure levels, selected based on their effects on population, buildings and equipment were modeled using PHAST.

6.4.4 TOXIC HAZARD

The inhalation of toxic gases can give rise to effects, which range in severity from mild irritation of the respiratory tract to death. Lethal effects of inhalation depend on the concentration of the gas to which people are exposed and on the duration of exposure. Mostly this dependence is nonlinear and as the concentration increases, the time required to produce a specific injury decreases rapidly.

The hazard distances to Immediately Dangerous to Life and Health concentration (IDLH) limit is selected to determine the extent of the toxic hazard Created as the result of loss of containment of a toxic substance.

6.5 CONSEQUENCE ANALYSIS FOR GT-IV

This section discusses the consequences of selected failure scenarios for GT-IV whose affect zones crosses the respective unit's B/L and causes worst consequences. The consequence distances are reported in tabular form for all weather conditions in **Annexure-I** and are represented graphically in **Annexure-II** for the all failure scenarios in GT-IV for worst weather conditions.

6.5.1 GT-IV

NOTE: Refer Figures 6.5.1 to 6.5.10 in Annexure-II

NG Supply line to KOD-5 mm leak: From the incident outcome analysis of the selected failure scenario it is observed that LFL hazard distance is extended up to 3 m. The Jet Fire radiation intensity of 37.5 & 12.5 kW/m² are not realized for this scenario.

NG Supply line to KOD-10 mm leak: From the results of consequence analysis it is observed that LFL hazard zone may reach up to a distance of 6 m covering OWS pump station and pipe racks on the northern sides. The 12.5 Kw/m² radiation intensity due to jet fire may extend up to a

distance of 9 m affecting OWS pump station, pipe racks on the northern side depending upon direction of the release.

NG Supply line to KOD-20 mm leak: From the event outcome of the selected failure scenario it is observed that LFL hazard zone may reach up to a distance of 12 m covering OWS pump station, pipe racks on the northern side. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may extend up to a distance of 16 m & 20 m respectively, affecting OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid. The 5 & 3 psi blast wave may extend up to a distance of 13 m & 14 m respectively and affects OWS pump station, pipe racks on the northern side, existing GCS for GT-3.

NG Supply line to KOD-50 mm leak: From the results of consequence analysis it is observed that LFL hazard zone may reach up to a distance of 40 m covering OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4, condensate tank area. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may extend up to a distance of 38 m & 49 m respectively, affecting OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1,2,4, condensate tank area, pipe slippers / rack depending upon direction of the release. The 5 & 3 psi blast wave may extend up to a distance of 39 m & 43 m respectively and affecting OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4, condensate tank area, pipe slippers/rack.

NG Steam heater outlet-10 mm leak: From the incident outcome analysis of the selected failure scenario it is observed that LFL hazard distance is extended up to 6 m. The Jet Fire radiation intensity of 37.5 kW/m² is not realized & 12.5 kW/m² radiation intensity may reach upto a distance of 8 m from leak source affecting OWS Pump station.

NG Steam heater outlet-20 mm leak: From the results of consequence analysis it is observed that LFL hazard zone may reach up to a distance of 11 m covering OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may extend up to a distance of 15 m & 18 m respectively, affecting OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4, depending upon direction of the release. The 5 & 3 psi blast wave may extend up to a distance of 13 m & 14 m respectively and affects OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2 & 4.

Fine Filter Separator Outlet line- 10 mm leak: From the event outcome of the selected failure scenario it is observed that LFL hazard zone may reach up to a distance of 4 m. The Jet Fire radiation intensity of 37.5 & 12.5 kW/m² are not realized for this scenario.

Fine Filter Separator Outlet line- 20 mm leak: From the results of consequence analysis it is observed that LFL hazard zone may reach up to a distance of 8 m covering existing GCS for GT-

3, proposed GCS for GT-1, 2, 4. The 12.5 Kw/m² radiation intensity due to jet fire may extend up to a distance of 13 m, affects OWS pump station, pipe racks, existing GCS for GT-3, filter skid, proposed GCS for GT-1,2,4, depending upon direction of the release.

HRSG-4 Inlet line- 10 mm leak: From the event outcome of the selected failure scenario it is observed that LFL hazard zone may reach up to a distance of 2 m.

HRSG-4 Inlet line- 20 mm leak: From the results of consequence modelling it is observed that LFL hazard zone may reach up to a distance of 4 m. The Jet Fire radiation intensity of 37.5 & 12.5 kW/m² are not realized for this scenario.

7 DETAILED ANALYSIS & RECOMMENDATIONS

The detailed consequence analysis of release of hydrocarbon in case of major credible scenarios are modeled in terms of release rate, dispersion, flammability and toxic characteristics, which have been discussed in detail in the report. The detailed analysis and recommendations arising out of the Rapid Risk analysis study for GT-IV are summarized below and are based on findings as reported in Section - 6:

Both high & low frequency flammable scenarios are modeled for hydrocarbon handling section of new proposed GT-IV Package.

- It is observed that the consequence outcomes (radiation & explosion) in the event of leak scenarios in KOD inlet section (5 mm, 10 mm, 20 mm & 50 mm), NG Steam heater outlet (10 mm & 20 mm), Fine Filter Separator Outlet line (10 mm & 20 mm) may affect & damage the nearby equipment's such as OWS pump station, pipe racks on the northern side, existing GCS for GT-3, filter skid, proposed GCS for GT-1, 2, 4 and condensate tank area.

Hence, it is recommended to locate the hydrocarbon & fire detectors at strategic locations near to these equipment's and provide adequate passive fire protection for the supports of affected equipment's / pipe racks. It is also recommended to ensure adequate fire-fighting provisions and remote isolation provisions for NG handling equipment / piping.

- Consequence outcomes (radiation & explosion) are also modelled for Fine Filter Separator Outlet line (10 mm & 20 mm) and HRSG-4 Inlet line (10 mm & 20 mm), near the GT-IV Gas metering station area and it is observed that Flash Fire & 12.5 Kw/m² Jet Fire radiation intensity may affect the nearby equipment's in GT-IV area.

It is recommended to select the electrical fittings in GT-IV package as per the Hazardous Area Classification study and install the hydrocarbon & fire detectors at strategic locations in GT-IV area. It is also recommended to provide adequate passive fire protection for the supports of equipment's / pipe racks in GT-IV area and ensure adequate fire-fighting provisions in GT-IV area.

It is also recommended to ensure proper electrical fittings selection & hydrocarbon gas evacuation / ventilation for the GT Hall (Indoor) in event of hydrocarbon leakage inside GT Hall (Indoor). SOP to address steps to be taken by operator in event of gas leakage inside GT Hall (Indoor). Adequate provisions for gas / fire detection & remote isolation for Natural Gas lines to be provided inside GT Hall (Indoor).

Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk.

a) Recommendations for Construction Safety during execution of the Project

- ✓ *Adequate barricading of the new facilities to be done from existing running facilities during construction phase. Hydrocarbon / toxic detectors to be placed along the barricading suitably to detect any hydrocarbon / toxic gas in vicinity of construction area. Also, adequate firefighting & toxic gas handling arrangement are to be ensured in the construction area. Ensure training of persons associated with construction activities for response during fire & toxic gas release.*
- ✓ *Proper material movement path within the Complex shall be identified during the construction phase of the project.*
- ✓ *Detailed HSE Plan & HSE Philosophy to be developed by contractors during construction phase of the project, in line with client's safety requirements.*

b) General Recommendations

- ✓ *No new Operator Cabin / manned station to be located inside battery limits of new proposed GT-IV.*
- ✓ *Proper checking of contract people for smoking or inflammable materials to be ensured at entry gates to avoid presence of any unidentified source of ignition.*
- ✓ *Ensure vehicles entering the Complex are fitted with spark arrestors, as a mandatory item.*
- ✓ *In order to prevent secondary incident arising from any failure scenario, it is recommended that sprinklers and other protective devices are regularly checked to ensure they are functional.*
- ✓ *Mock drills to be organized at organization level to ensure preparation of the personnel's working in Complex for handling any hazardous situation.*
- ✓ *For positively pressurized building, both Hydrocarbon & Toxic detectors need to be placed at suction duct of HVAC. HVAC to be tripped automatically in event of the detection of any Hydrocarbon / toxic material by detector.*

c) Mitigating Measures

Mitigating measures are those measures in place to minimize the loss of containment event and, hazards arising out of Loss of containment. These include:

- ✓ *Early detection of an undesirable event (HC leak, Toxic gas leak, Flame etc.) and development of subsequent quick isolation mechanism for major inventories.*
- ✓ *Measures for controlling / minimization of Ignition sources inside the complex.*
- ✓ *Active and Passive Fire Protection for critical equipment's and major structures*
- ✓ *Effective Emergency Response plans to be in place*

d) Ignition Control

- ✓ *Ignition control will reduce the likelihood of fire events. This is the key for reducing the risk within facilities processing flammable materials. As part of mitigation measure it strongly recommended to consider minimization of the traffic movement within the Complex.*

e) Escape Routes

- ✓ Ensure sufficient escape routes from the site are available to allow redundancy in escape from all areas.
- ✓ Ensure sufficient number of windsocks throughout the site to ensure visibility from all locations. This will enable people to escape upwind or crosswind from flammable / toxic releases.
- ✓ Provide sign boards marking emergency/safe roads to be taken during any exigencies.

f) Others

- ✓ Ensure removal of hammer blinds from the process facilities, if any.
- ✓ Closed sampling system to be considered for pressurized services like Natural Gas, LPG, Propylene etc.
- ✓ Recommended to use portable HC detector during sampling and maintenance etc.
- ✓ Provide breathing apparatus at strategic locations inside Complex.

8 GLOSSARY

CASUALTY	Someone who suffers serious injury or worse i.e. including fatal injuries. As a rough guide fatalities are likely to be half the total casualties. But this may vary depending on the nature of the event.
HAZARD	A chemical or physical condition with the potential of causing damage.
FLAMMABILITY LIMITS	In fuel-air systems, a range of compositions exists inside which a (UFL – LFL) flame will propagate substantial distance from an ignition source. The limiting fuel concentrations are termed as Upper flammability or explosives limit (Fuel concentrations exceeding this are too rich) and Lower flammability or explosives limit (Fuel concentrations below this are too lean).
FLASH FIRE	The burning of a vapor cloud at very low flame propagation speed. Combustion products are generated at a rate low enough for expansion to take place easily without significant overpressure ahead or behind the flame front. The hazard is therefore only due to thermal effects.
OVERPRESSURE	Maximum pressure above atmosphere pressure experiences during the passage of a blast wave from an explosion expressed in this report as pounds per square inch (psi).
EXPLOSION	A rapid release of energy, which causes a pressure discontinuity or shock wave moving away from the source. An explosion can be produced by detonation of a high explosive or by the rapid burning of a flammable gas cloud. The resulting overpressure is sufficient to cause damage inside and outside the cloud as the shock wave propagation into the atmosphere beyond the cloud. Some authors use the term deflagration for this type of explosion
DOMINO EFFECT	The effect that loss of containment of one installation leads to loss of containment of other installations
EVENT TREE	A logic diagram of success and failure combinations of events used to identify accident sequences leading to all possible consequences of a given initiating event.
TLV	“Threshold limit value” is defined as the concentration of the substance in air that can be breathed for five consecutive 8 hours work day (40 hours work week) by most people without side effect.
STEL	“Short Term Exposure Limit” is the maximum permissible average exposure for the time period specified (15 minutes).

IDLH	“Immediate Dangerous to Life and Health” is the maximum concentration level from which one could escape within 30 minutes without any escape impairing symptoms.
PASQUILL CLASS	Classification to qualify the stability of the atmosphere, indicated by a letter ranging from A, for very unstable, to F, for stable.
FREQUENCY	The number of times an outcome is expected to occur in a given period of time.

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ANNEXURE-I

CONSEQUENCE ANALYSIS HAZARD DISTANCES

GTG - IV Consequence Analysis Hazard Distances

Unit	SI No.	Equipment	Failure Case	Operating Conditions		Leak Rate Kg/s	Weather	Flash Fire (m)	Jet Fire (m)			Pool Fire (m)			Blast Over Pressure (m)			NOTE
				Temp. (°C)	Press. (Kg/cm ² g)				4 KW/m ²	12.5 KW/m ²	37.5 KW/m ²	4 KW/m ²	12.5 KW/m ²	37.5 KW/m ²	2 psi	3 psi	5 psi	
GT-IV	1	NG Supply Line to KOD	5 mm Leak	30	39	0.13	1.5 F	3	5	n/a	n/a	-	-	-	-	-	-	
							2 C	3	5	n/a	n/a	-	-	-	-	-	-	
							3 D	3	5	n/a	n/a	-	-	-	-	-	-	
	2	NG Supply Line to KOD	10 mm Leak	30	39	0.53	1.5 F	6	12	9	n/a	-	-	-	-	-	-	
							2 C	6	12	9	n/a	-	-	-	-	-	-	
							3 D	6	12	9	n/a	-	-	-	-	-	-	
	3	NG Supply Line to KOD	20 mm Leak	30	39	2.11	1.5 F	12	25	20	16	-	-	-	16	14	13	
							2 C	12	25	20	16	-	-	-	16	14	13	
							3 D	11	25	20	16	-	-	-	15	14	13	
	4	NG Supply Line to KOD	50 mm Leak	30	39	13.22	1.5 F	40	63	49	38	-	-	-	47	43	39	
							2 C	38	64	49	39	-	-	-	46	42	39	
							3 D	38	64	50	39	-	-	-	46	42	39	
	5	NG Steam heater Outlet	10 mm Leak	78	37.3	0.46	1.5 F	6	11	8	n/a	-	-	-	-	-	-	
							2 C	5	11	8	n/a	-	-	-	-	-	-	
							3 D	5	11	8	n/a	-	-	-	-	-	-	
	6	NG Steam heater Outlet	20 mm Leak	78	37.3	1.82	1.5 F	11	23	18	15	-	-	-	15	14	13	
							2 C	11	23	19	15	-	-	-	15	14	13	
							3 D	10	23	19	15	-	-	-	15	14	13	
	7	Fine Filter Separator Outlet Line	10 mm Leak	69	19.3	0.24	1.5 F	4	7	n/a	n/a	-	-	-	-	-	-	
							2 C	4	7	n/a	n/a	-	-	-	-	-	-	
							3 D	4	7	n/a	n/a	-	-	-	-	-	-	
	8	Fine Filter Separator Outlet Line	20 mm Leak	69	19.3	0.96	1.5 F	8	16	13	n/a	-	-	-	-	-	-	
							2 C	8	16	13	n/a	-	-	-	-	-	-	
							3 D	7	16	13	n/a	-	-	-	-	-	-	
	9	HRSG-4 Inlet line	10 mm Leak	64	4	0.06	1.5 F	2	n/a	n/a	n/a	-	-	-	-	-	-	
							2 C	2	n/a	n/a	n/a	-	-	-	-	-	-	
							3 D	2	n/a	n/a	n/a	-	-	-	-	-	-	
	10	HRSG-4 Inlet line	20 mm Leak	64	4	0.23	1.5 F	4	7	n/a	n/a	-	-	-	-	-	-	
							2 C	4	7	n/a	n/a	-	-	-	-	-	-	
							3 D	4	7	n/a	n/a	-	-	-	-	-	-	

ANNEXURE-II

FIGURES FOR CONSEQUENCE ANALYSIS

Figure 6.5.1 A: GT-IV: NG Supply line to KOD-5 mm leak; Flash Fire Distances (m)

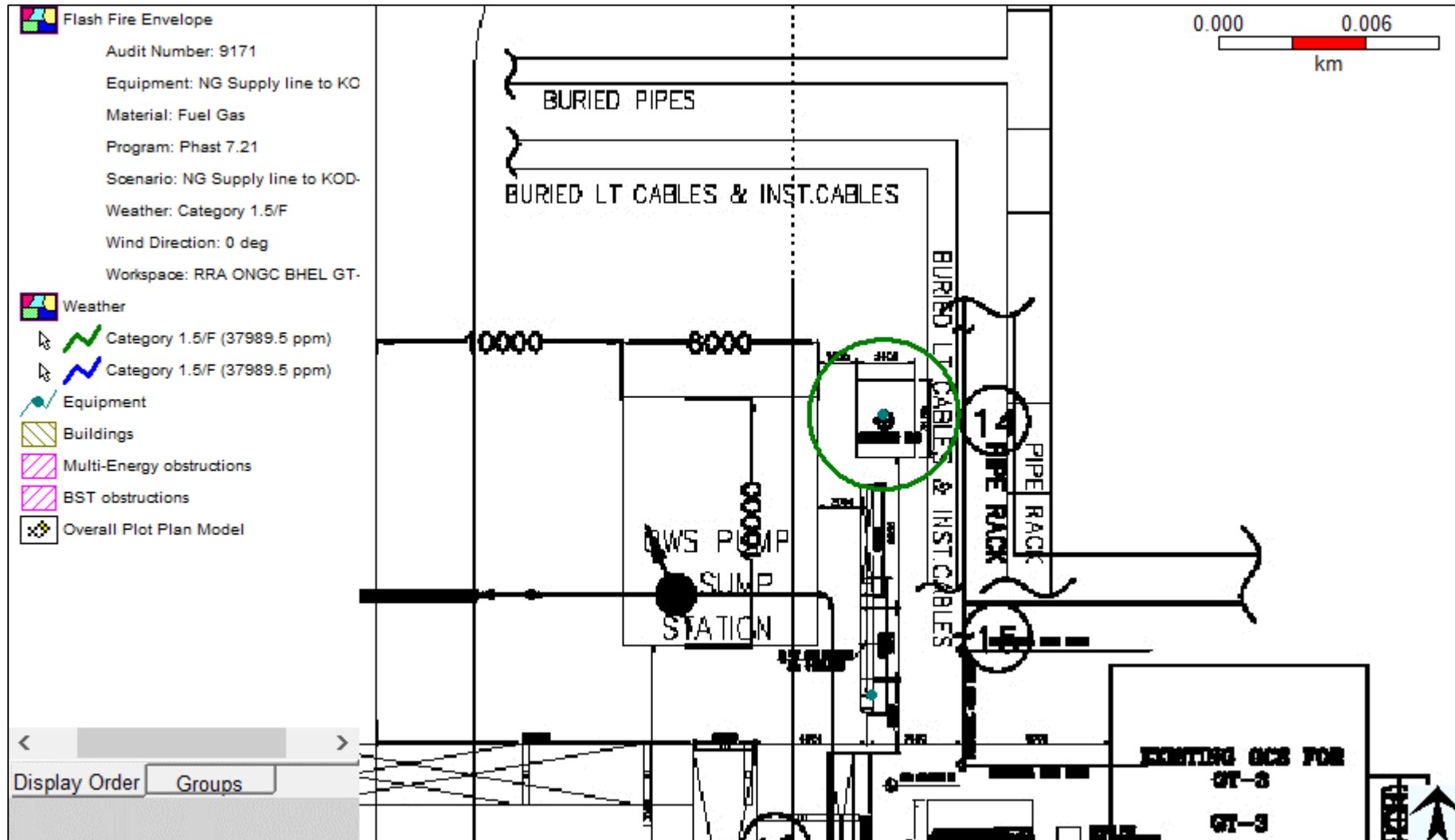


Figure 6.5.1 B: GT-IV: NG Supply line to KOD-5 mm leak; Jet Fire Distances (m)

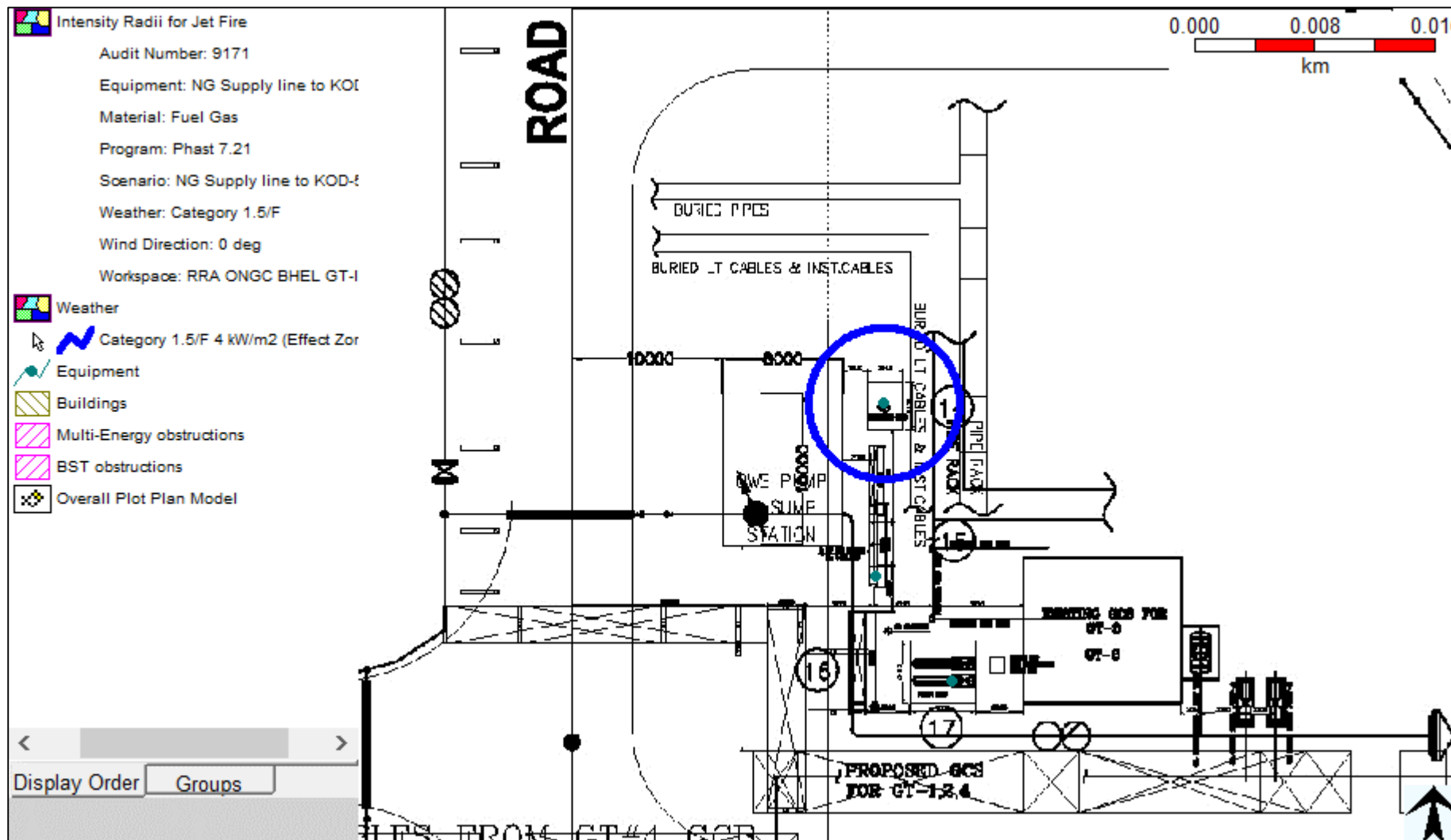


Figure 6.5.2 A: GT-IV: NG Supply line to KOD-10 mm leak; Flash Fire Distances (m)

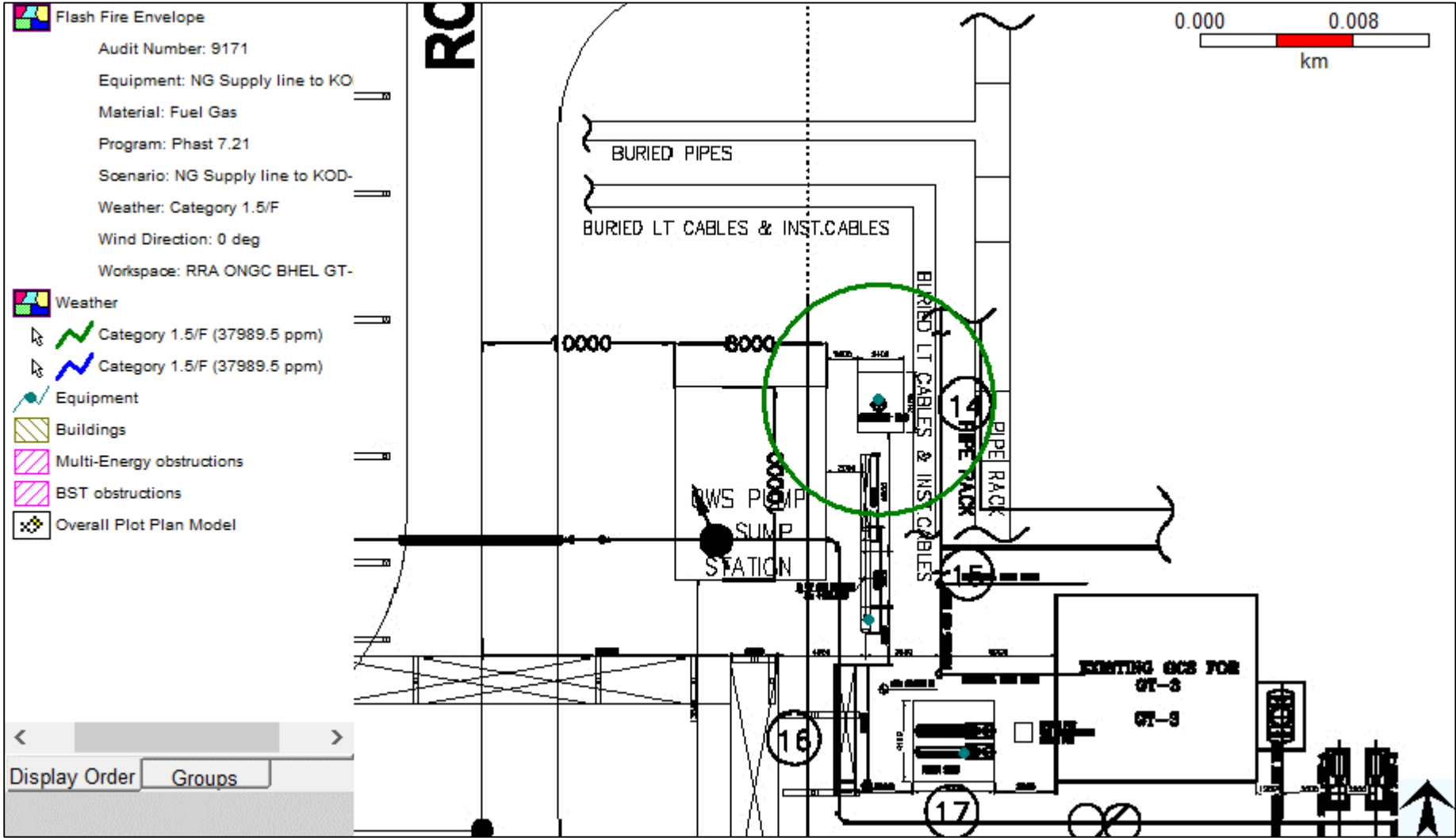


Figure 6.5.2 B: GT-IV: NG Supply line to KOD-10 mm leak; Jet Fire Distances (m)

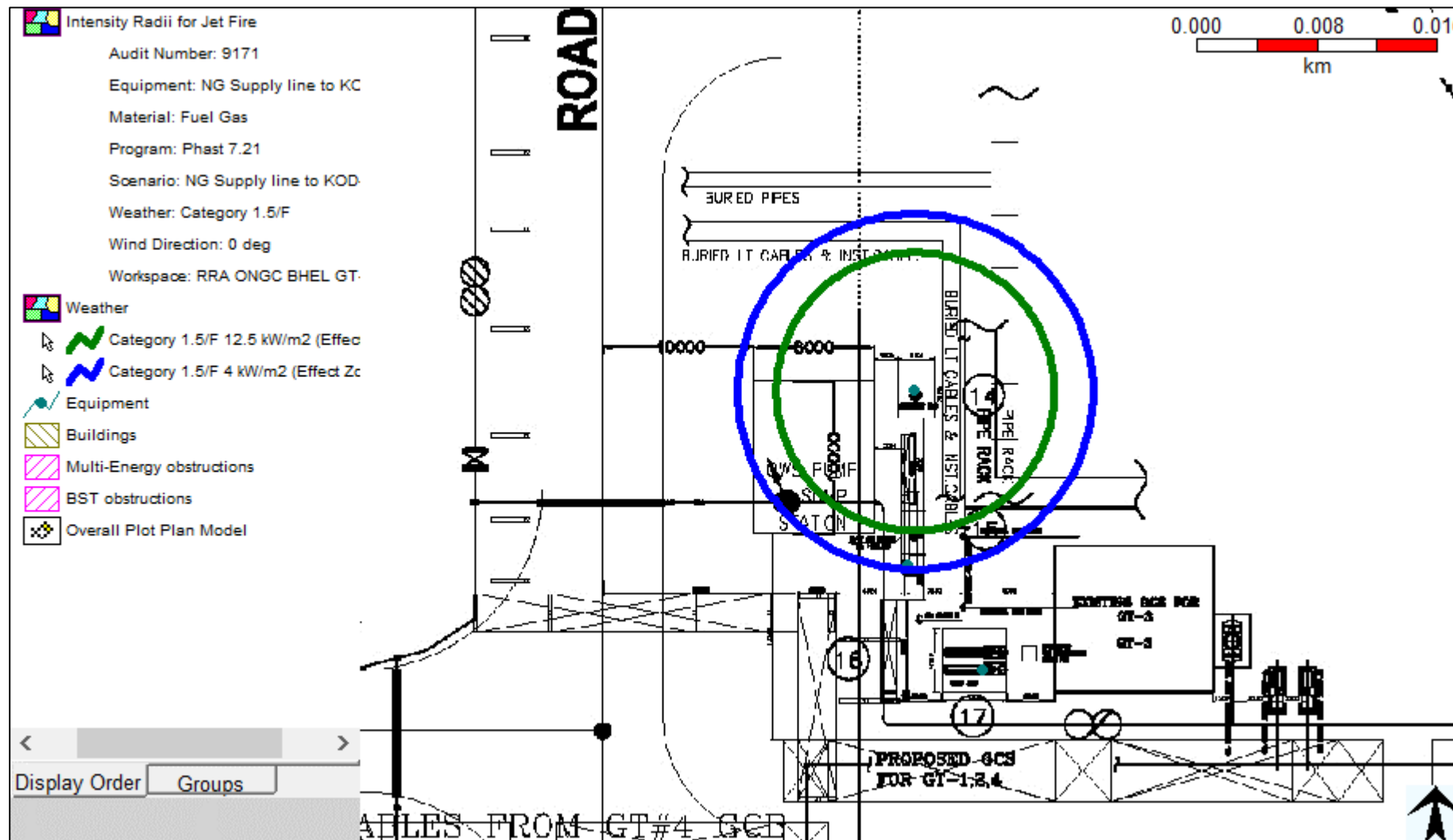


Figure 6.5.3 A: GT-IV: NG Supply line to KOD-20 mm leak; Flash Fire Distances (m)

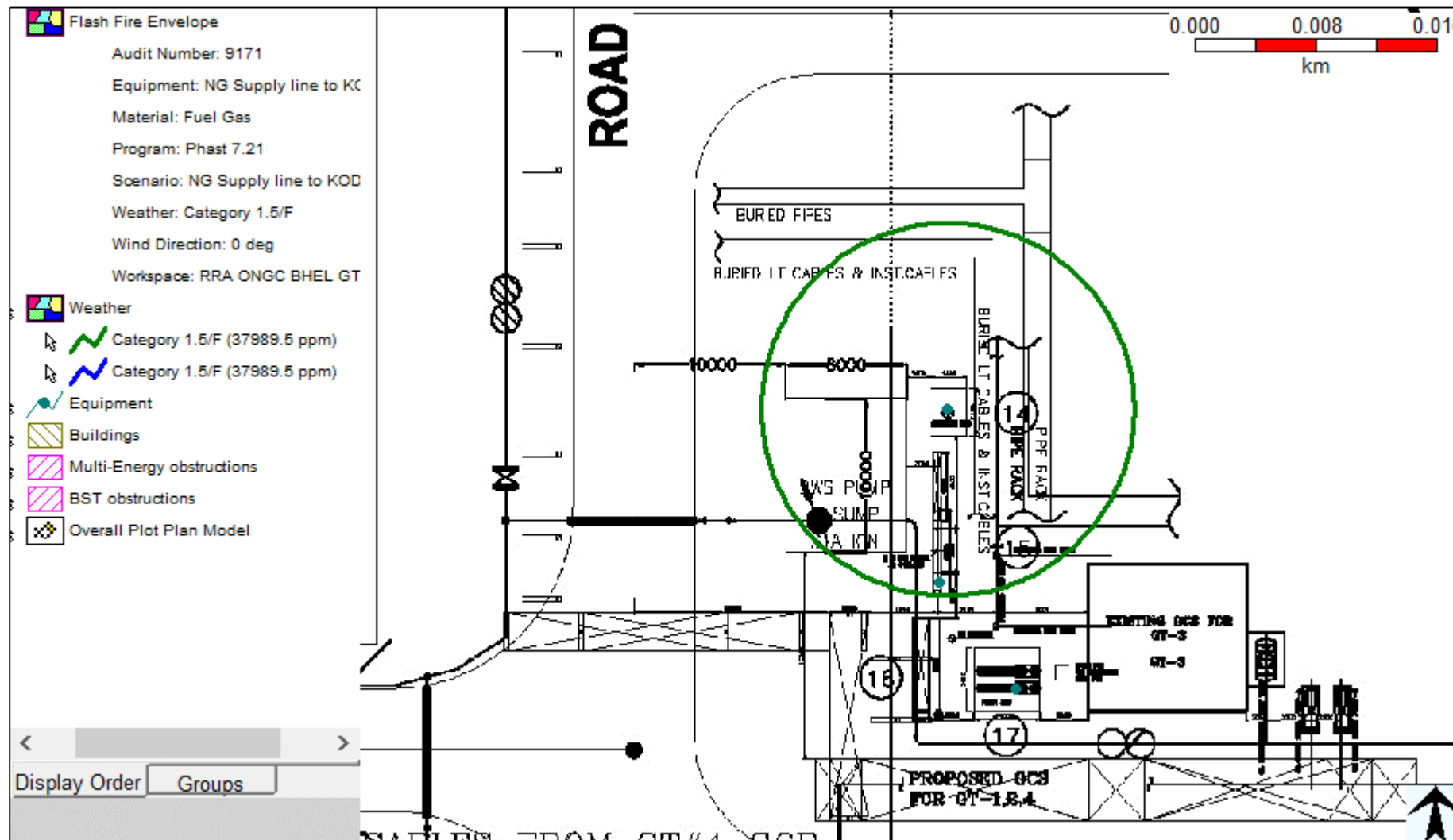


Figure 6.5.3 B: GT-IV: NG Supply line to KOD-20 mm leak; Jet Fire Distances (m)

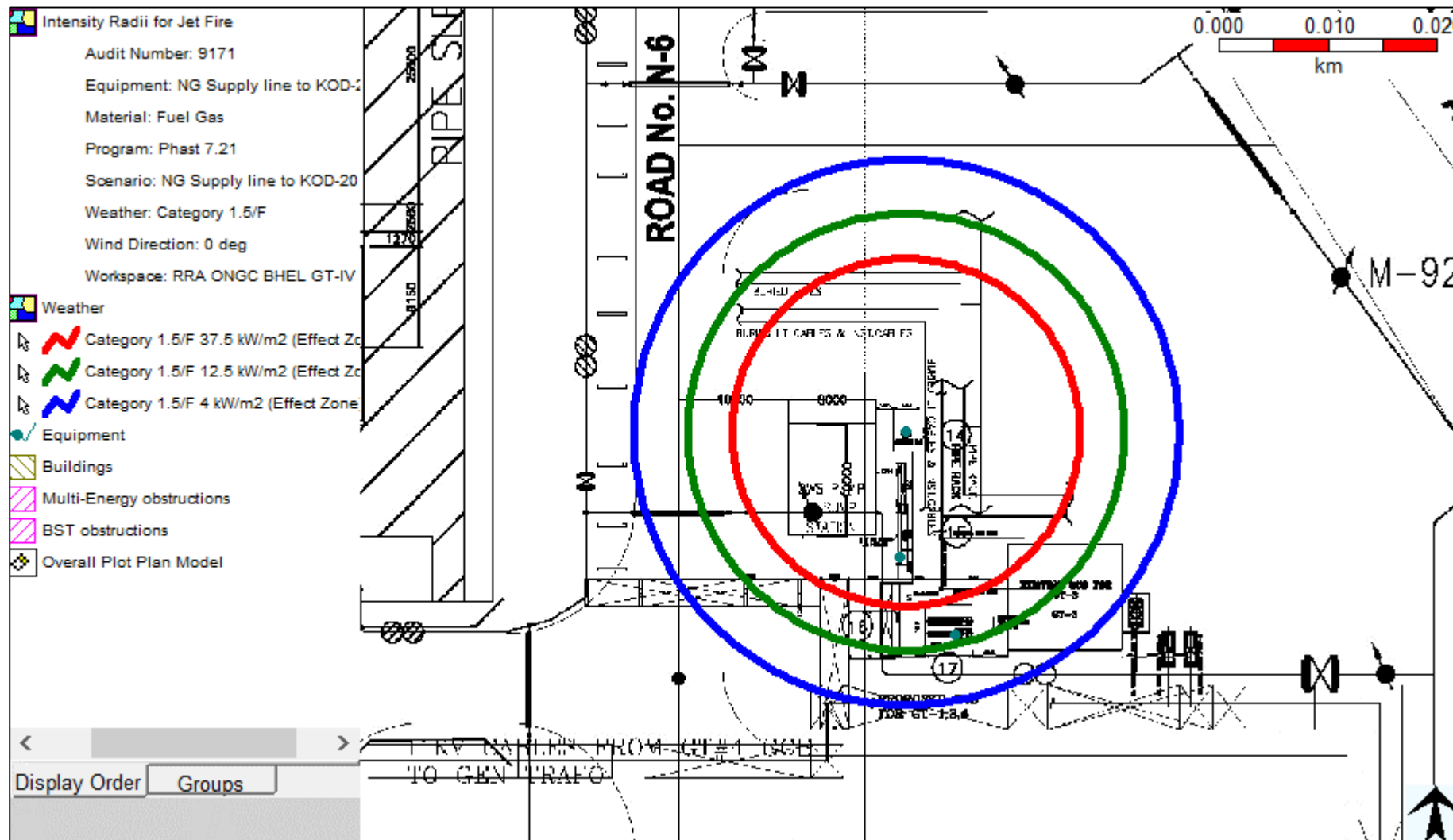


Figure 6.5.3 C: GT-IV: NG Supply line to KOD-20 mm leak; Overpressure Distances (m)

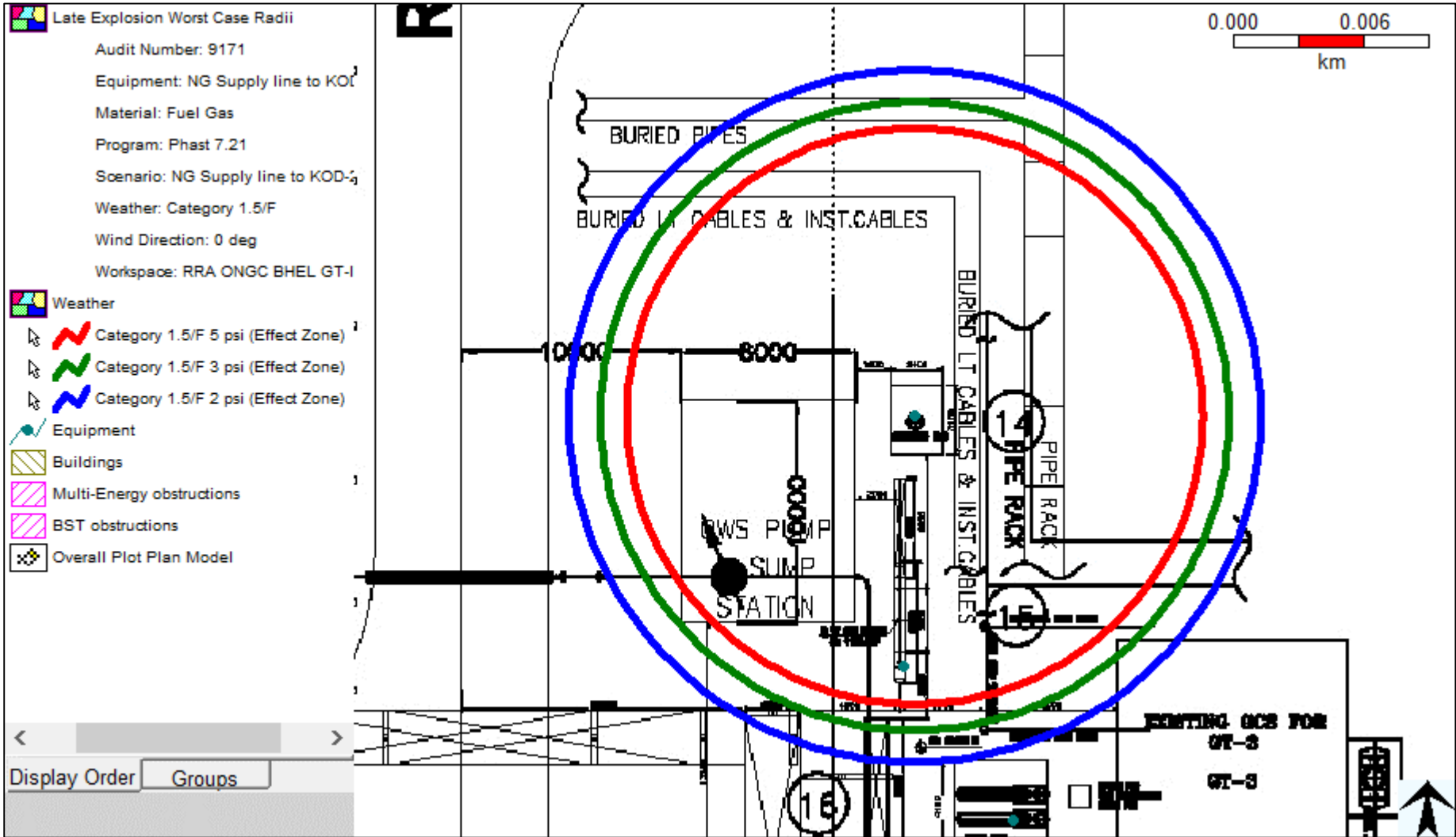


Figure 6.5.4 A: GT-IV: NG Supply line to KOD-50 mm leak; Flash Fire Distances (m)

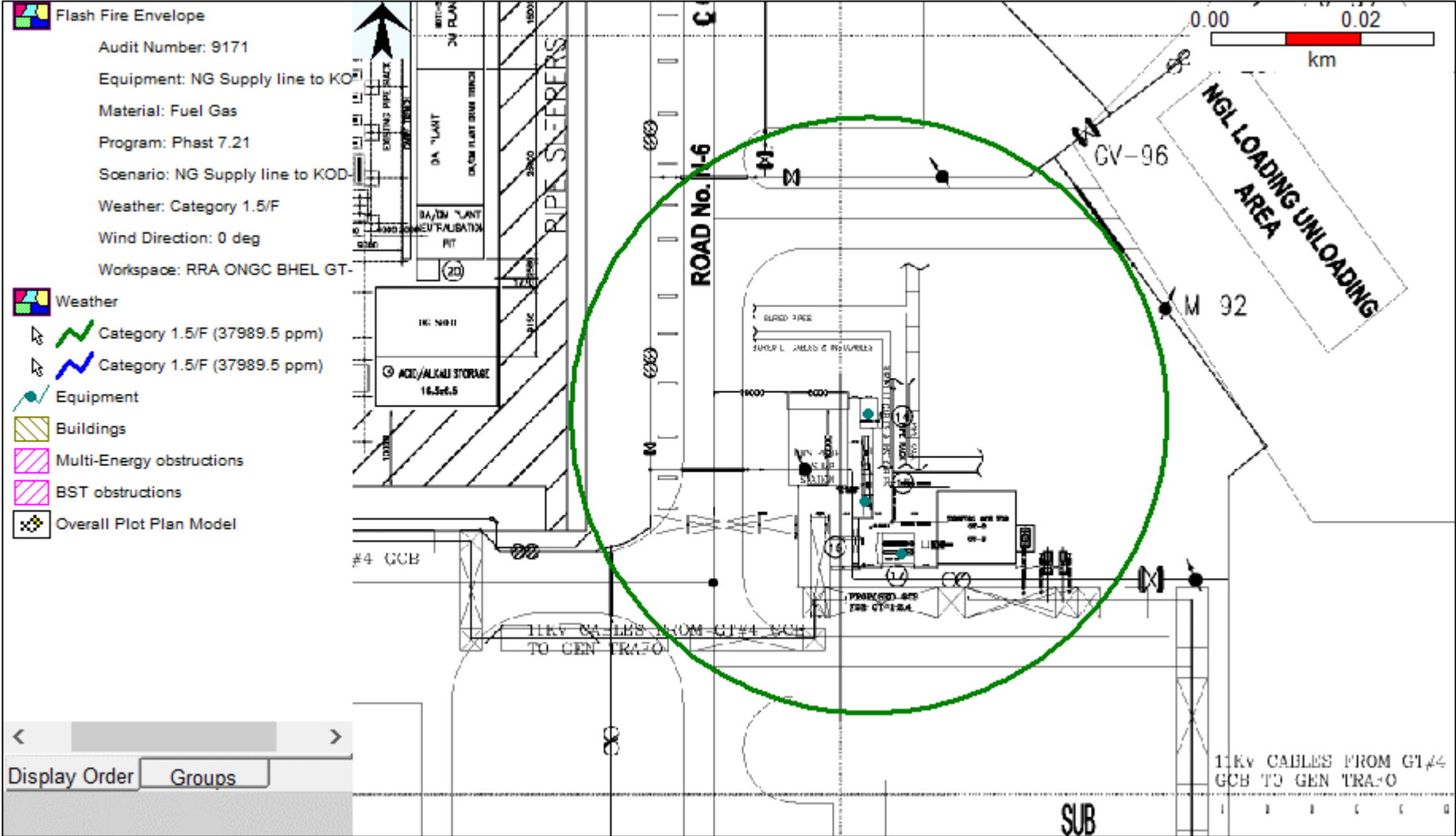


Figure 6.5.4 B: GT-IV: NG Supply line to KOD-50 mm leak; Jet Fire Distances (m)

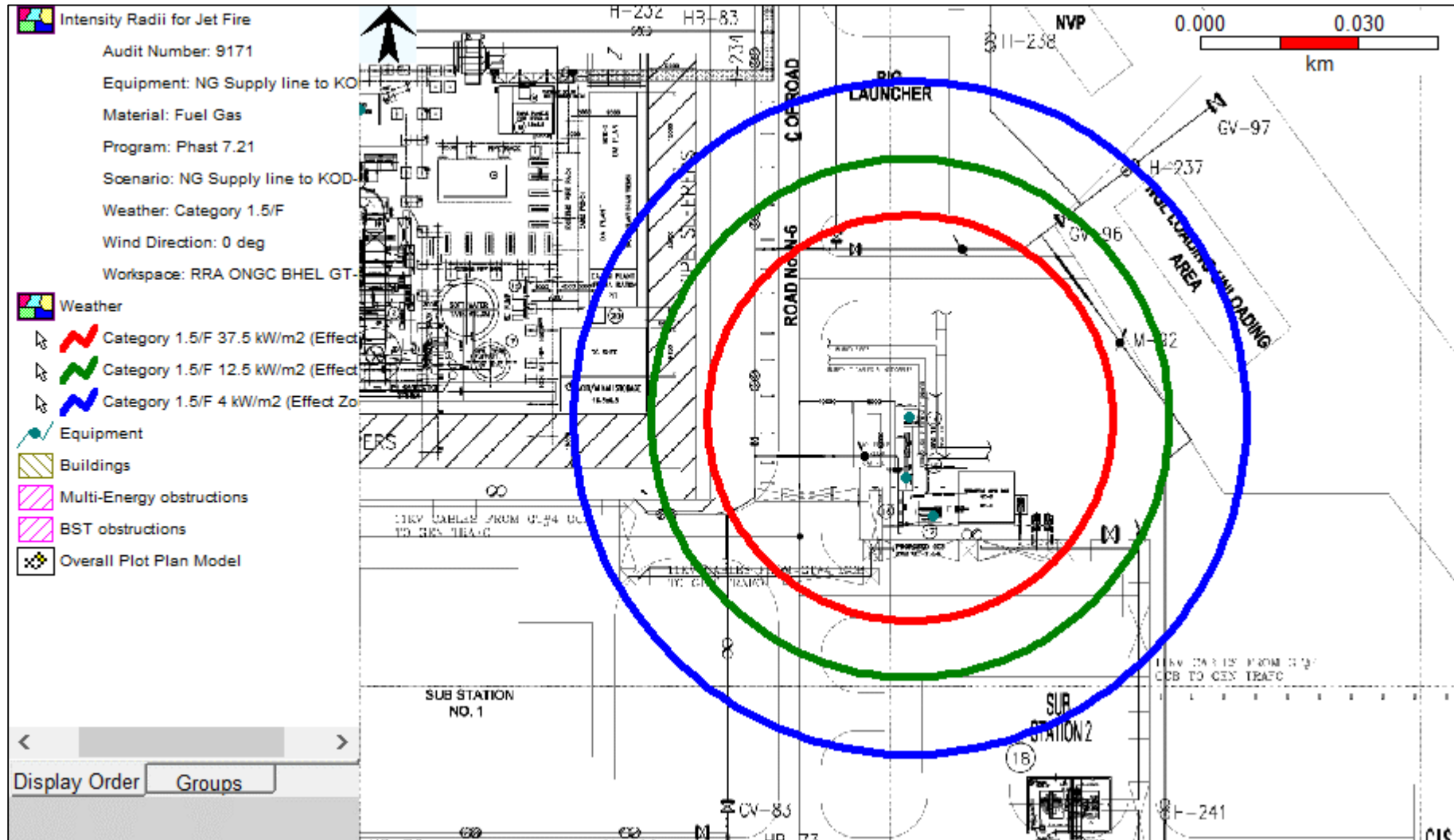


Figure 6.5.4 C: GT-IV: NG Supply line to KOD-50 mm leak; Overpressure Distances (m)

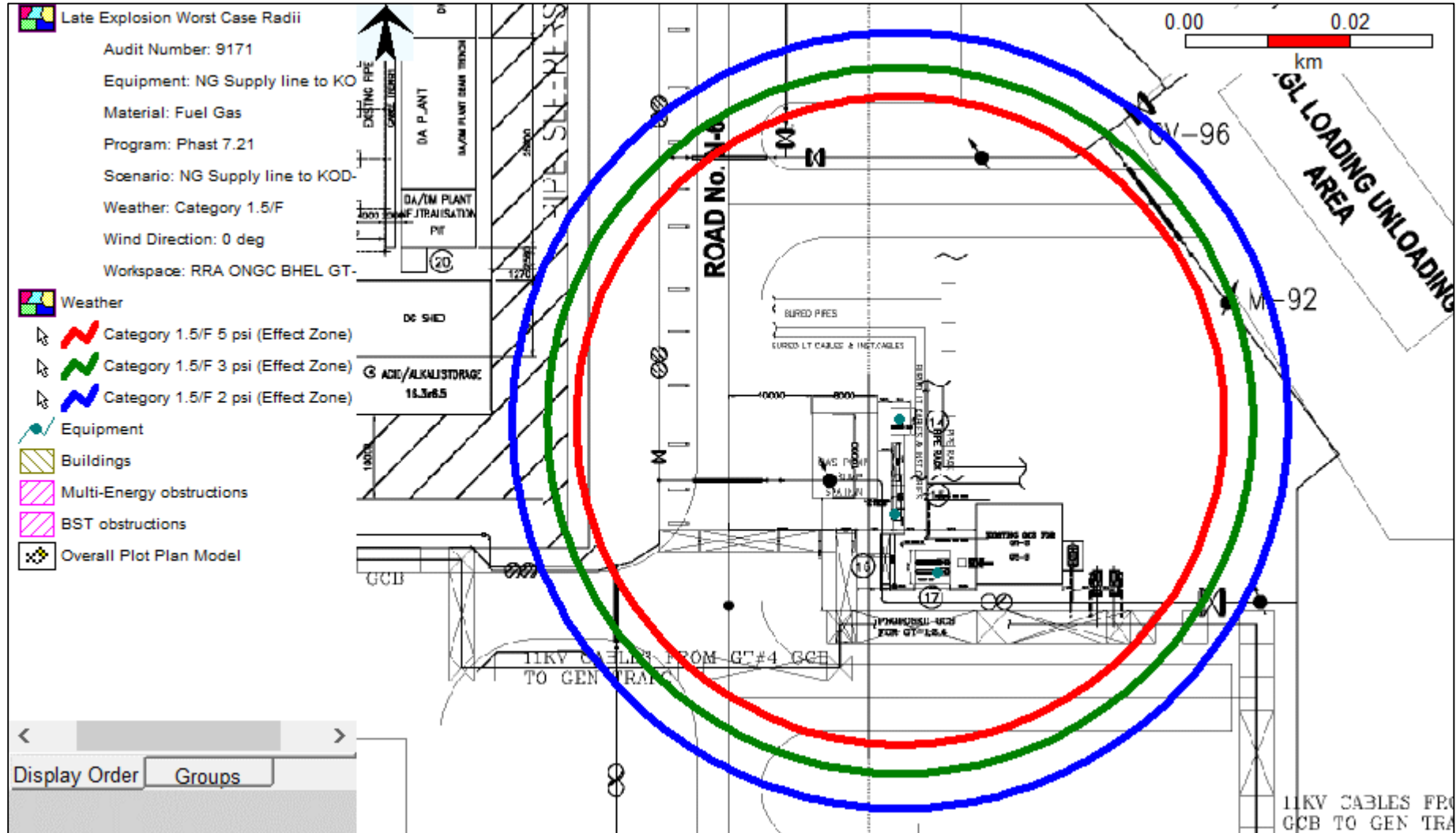


Figure 6.5.5 A: GT-IV: NG Steam heater outlet-10 mm leak; Flash Fire Distances (m)

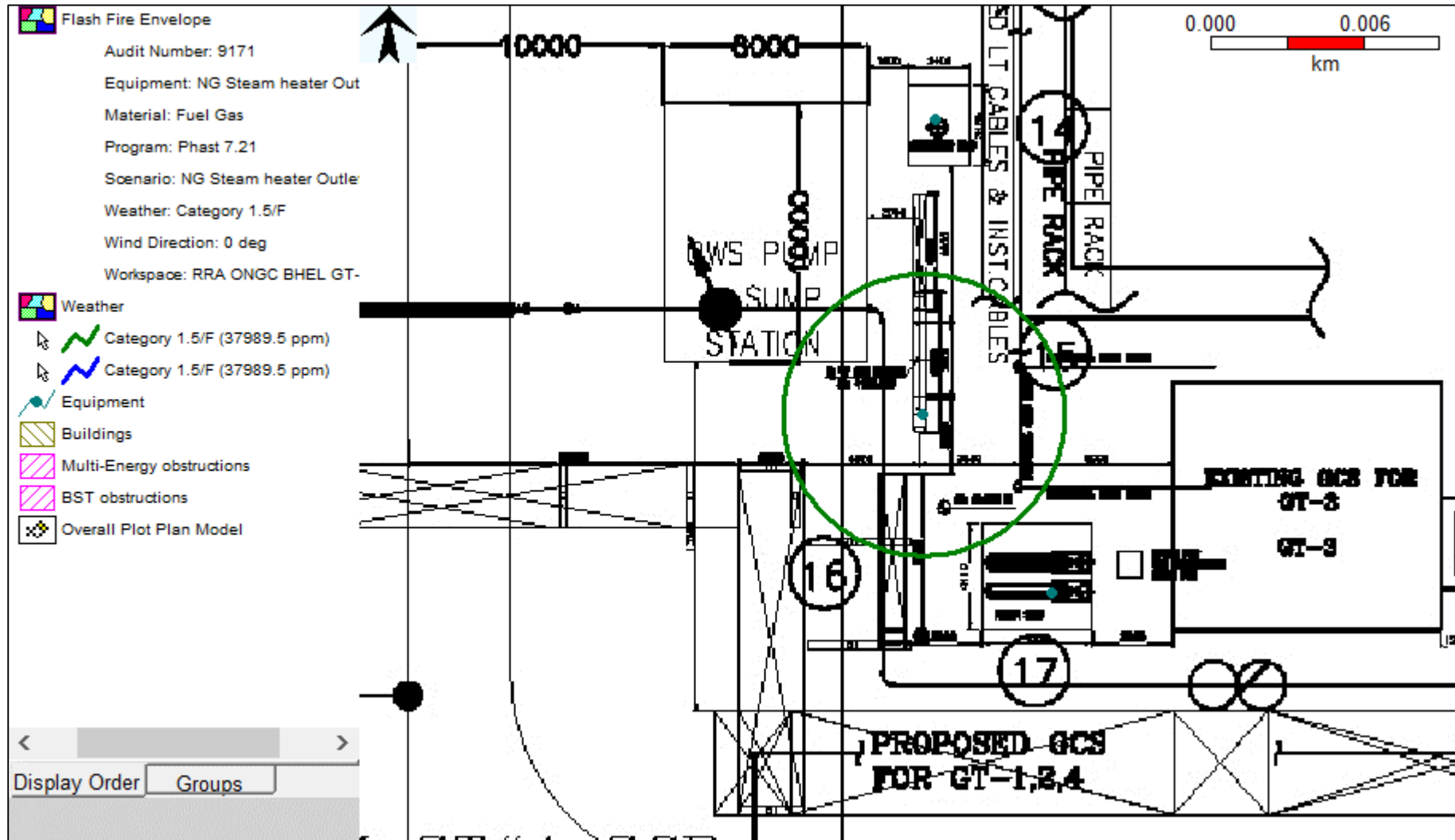


Figure 6.5.5 B: GT-IV: NG Steam heater outlet-10 mm leak; Jet Fire Distances (m)

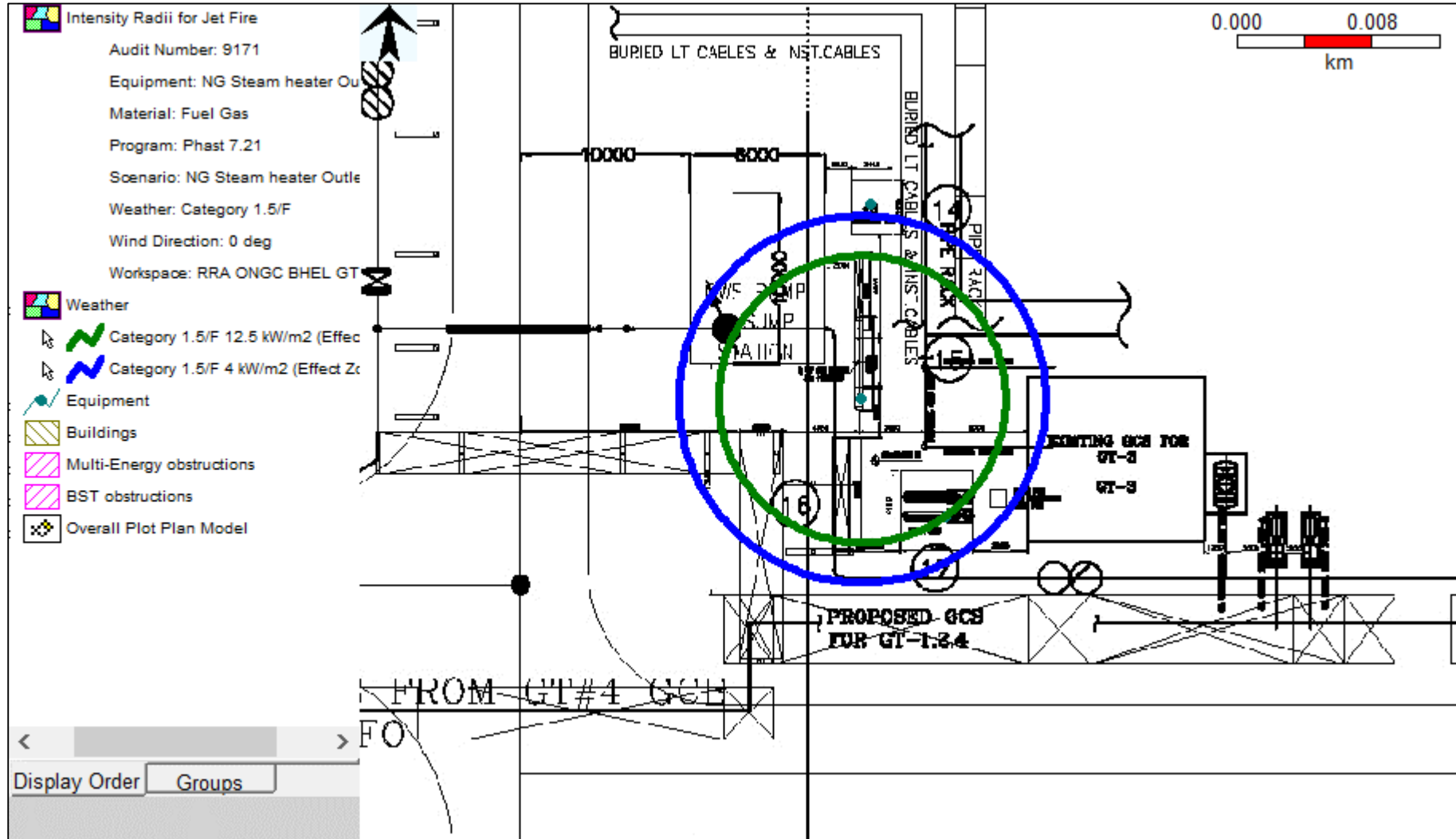


Figure 6.5.6 A: GT-IV: NG Steam heater outlet-20 mm leak; Flash Fire Distances (m)

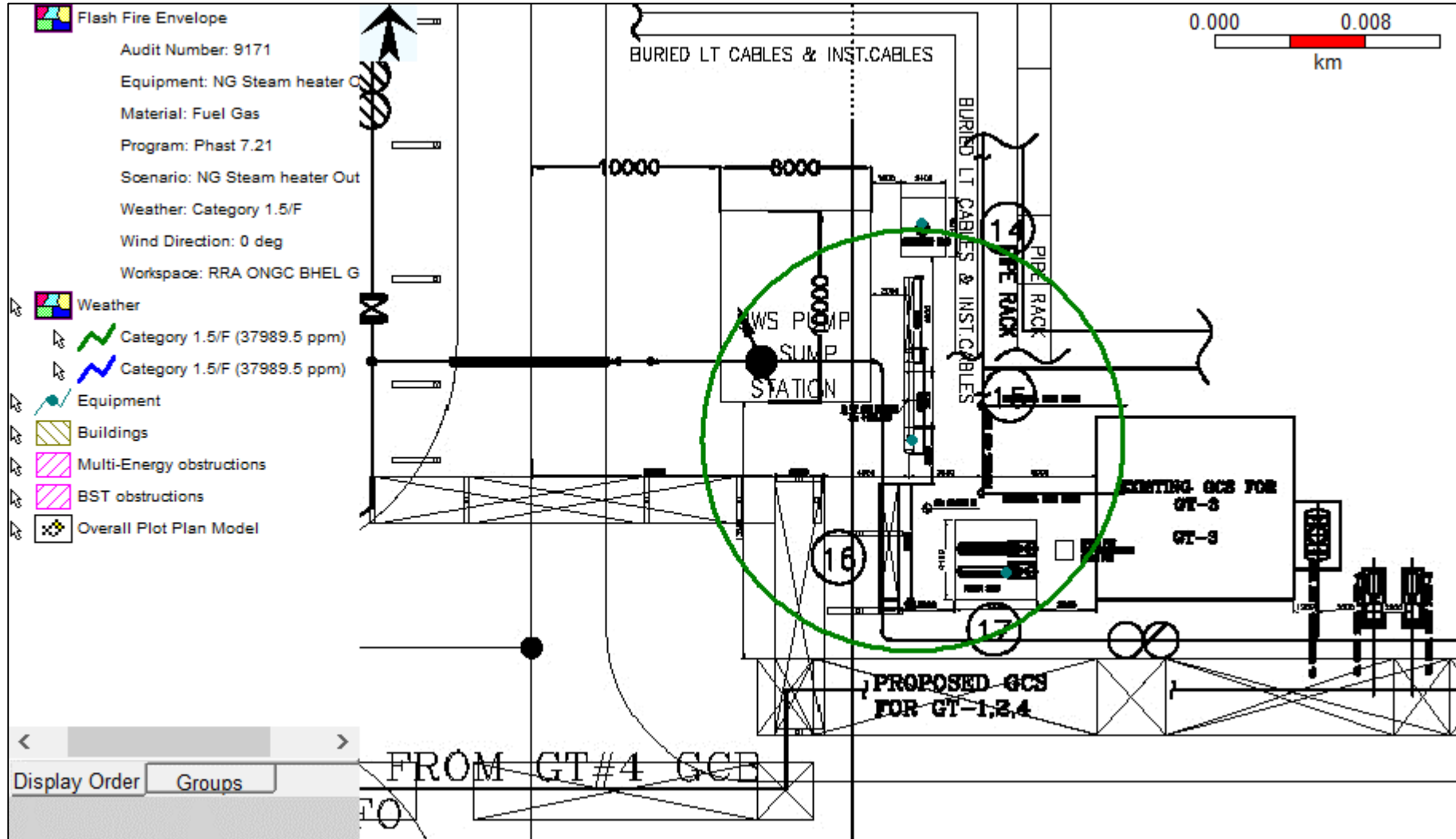


Figure 6.5.6 B: GT-IV: NG Steam heater outlet-20 mm leak; Jet Fire Distances (m)

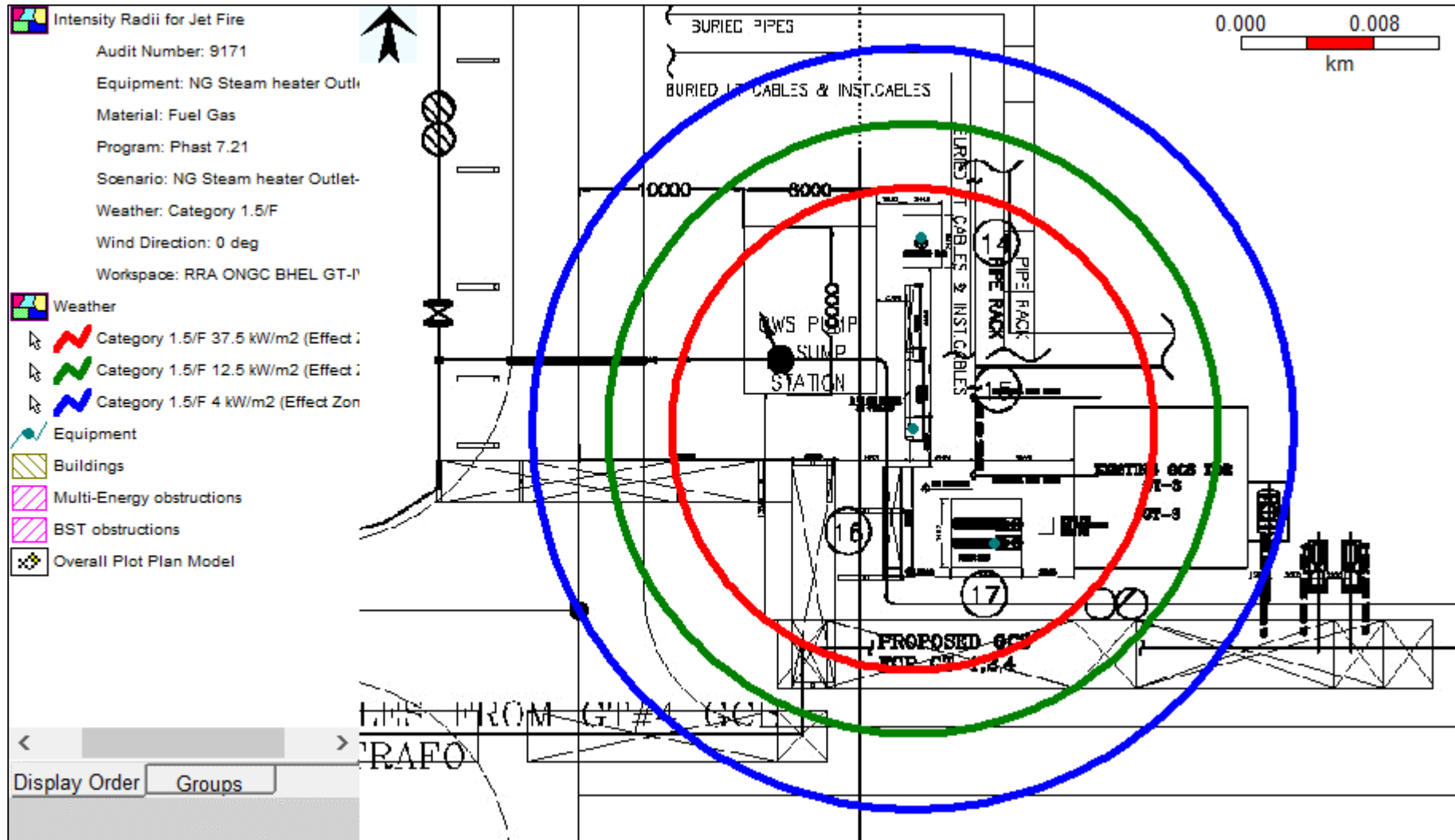


Figure 6.5.6 C: GT-IV: NG Steam heater outlet-20 mm leak; Overpressure Distances (m)

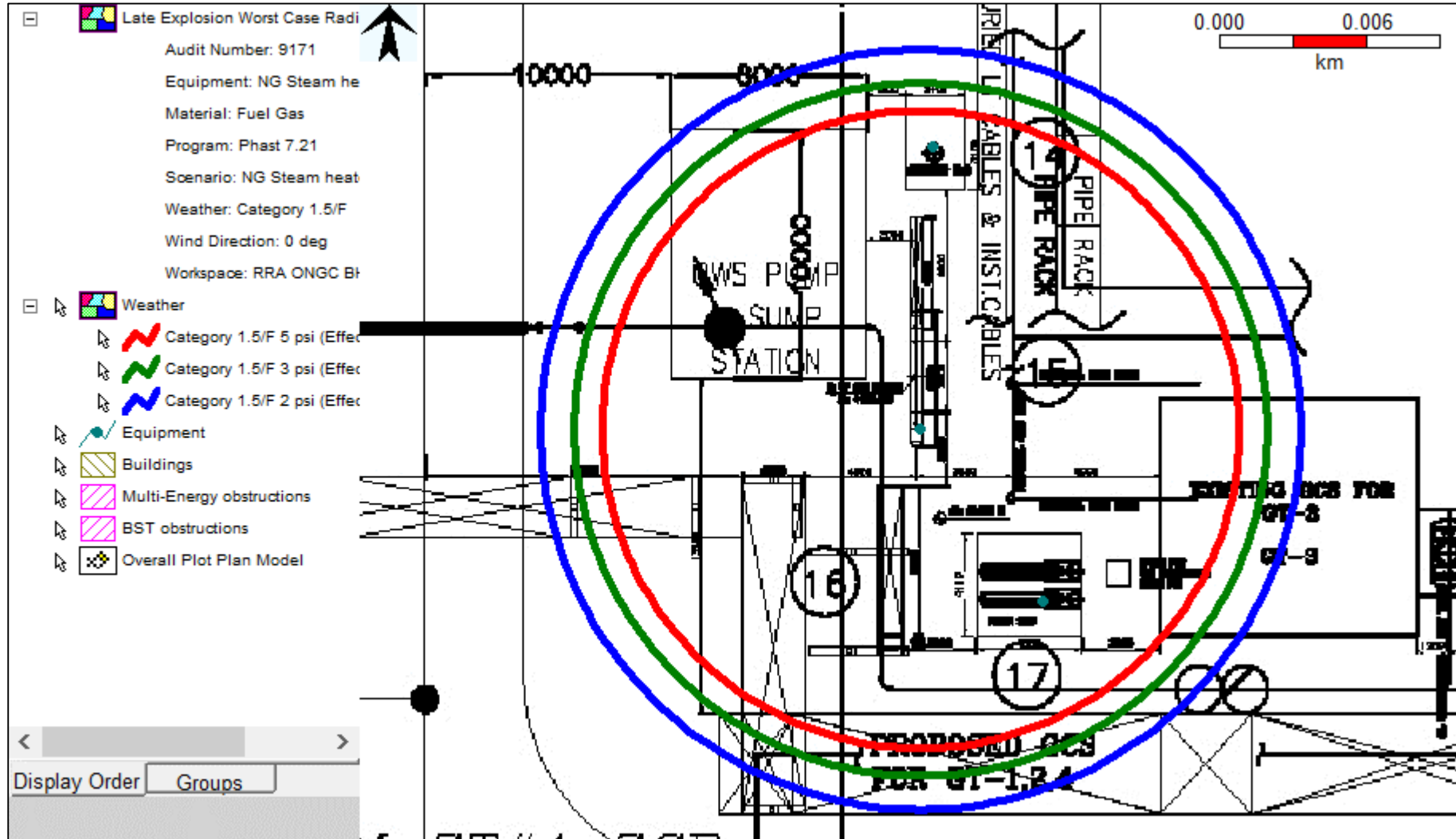


Figure 6.5.7 A: GT-IV: Fine Filter Separator Outlet line- 10 mm leak; Flash Fire Distances (m)

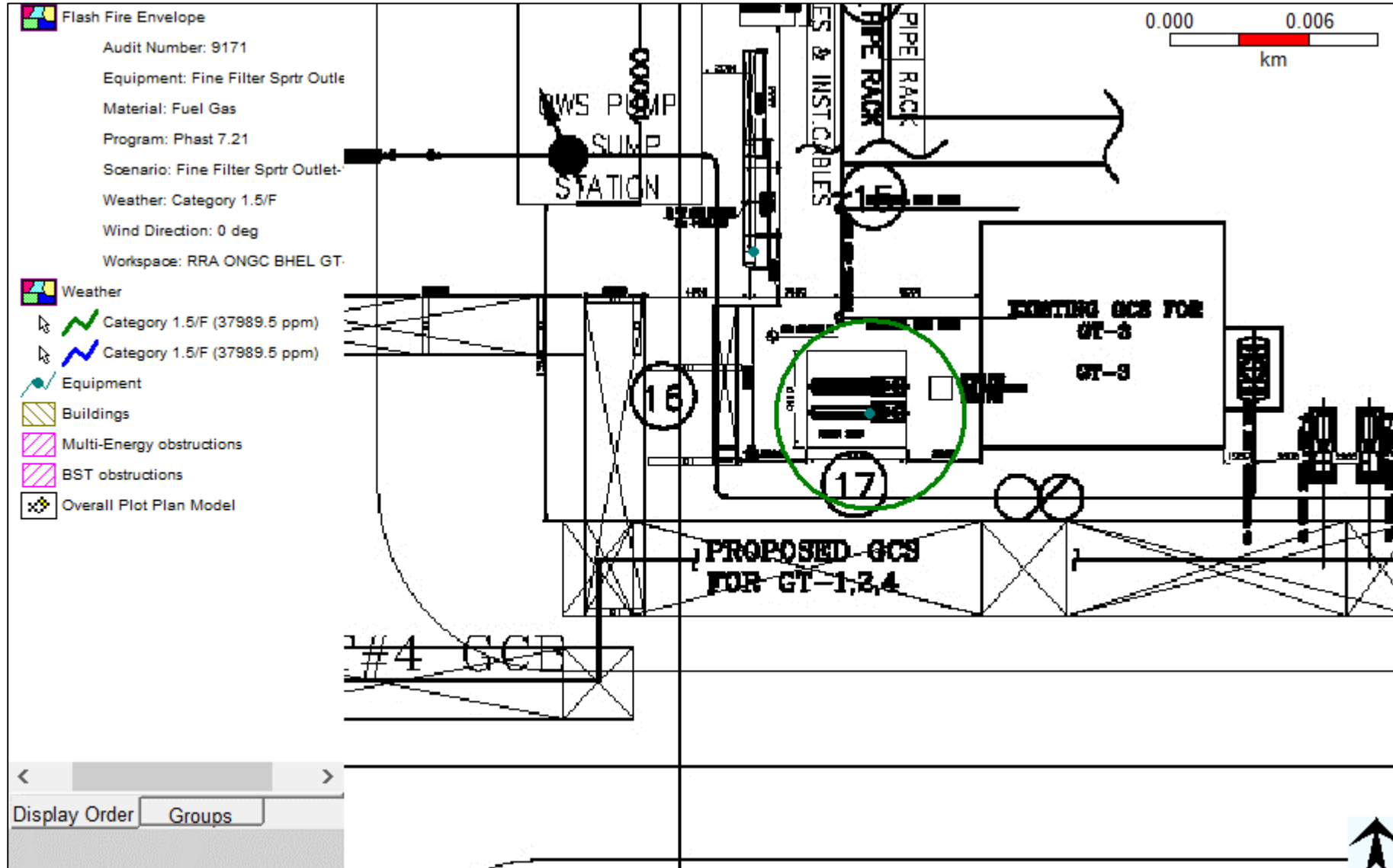


Figure 6.5.7 B: GT-IV: Fine Filter Separator Outlet line- 10 mm leak; Jet Fire Distances (m)

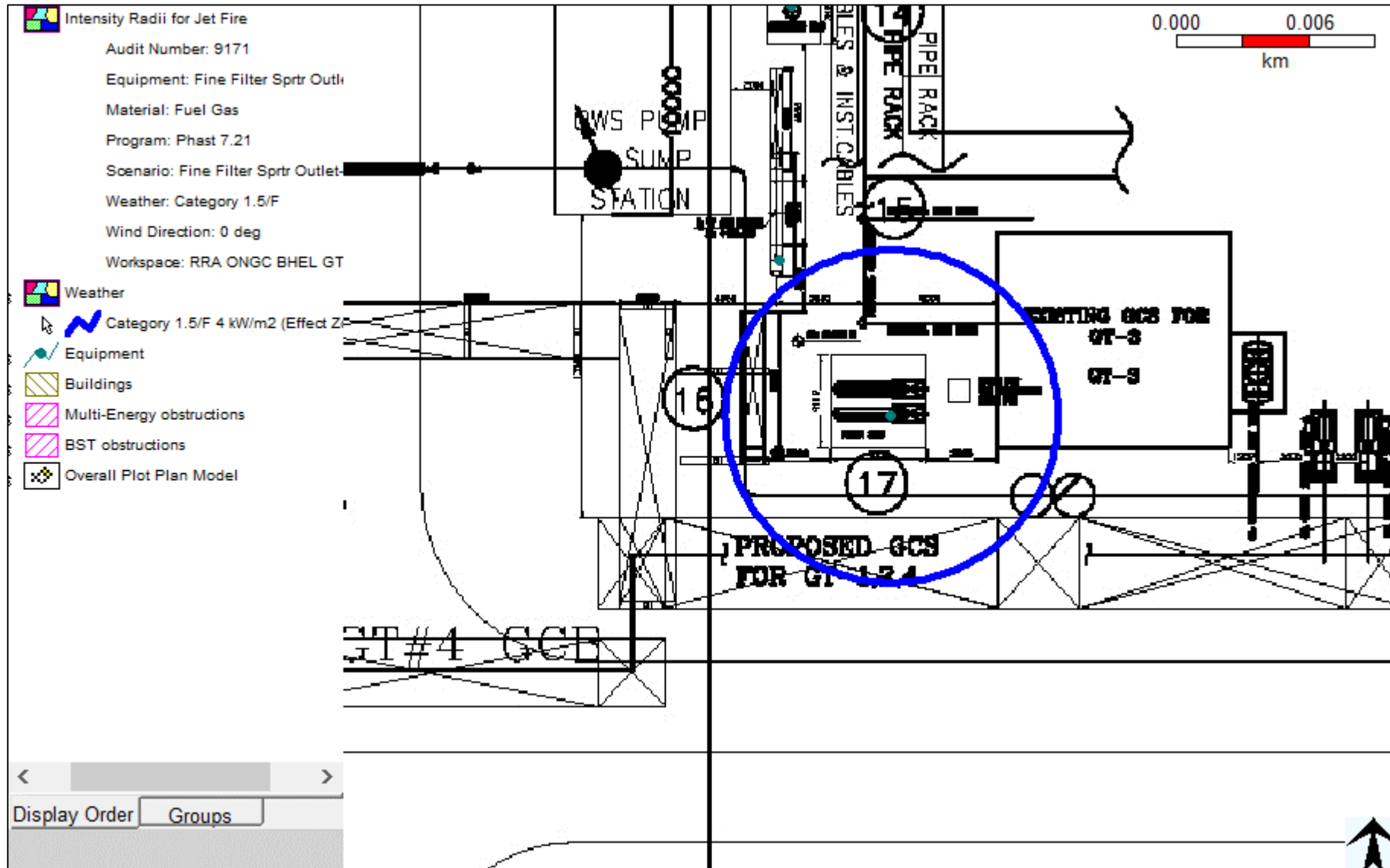


Figure 6.5.7 C: GT-IV: Fine Filter Separator Outlet line- 10 mm leak at Gas Metering Station; Flash Fire Distances (m)

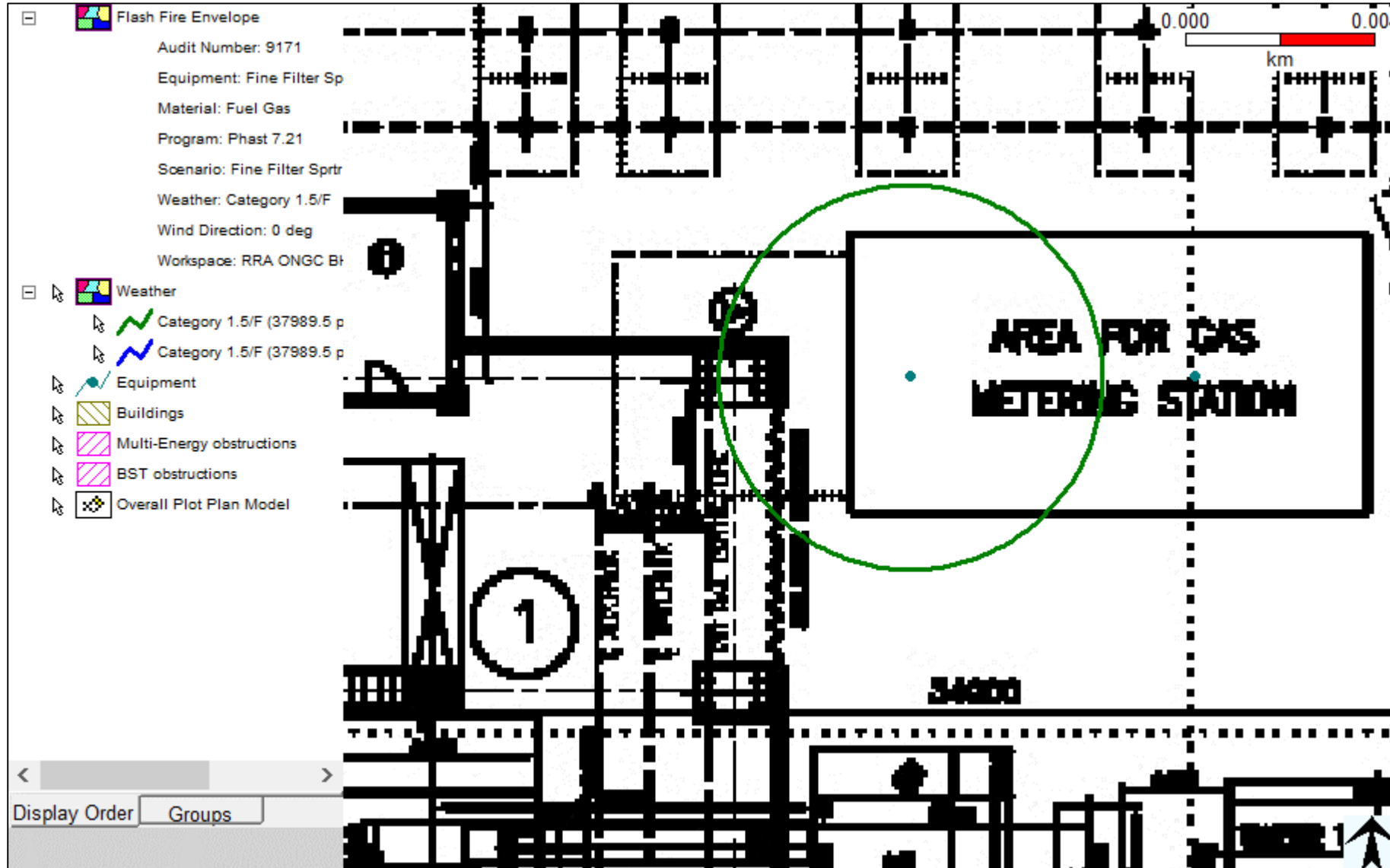


Figure 6.5.7 D: GT-IV: Fine Filter Separator Outlet line- 10 mm leak at Gas Metering Station; Jet Fire Distances (m)

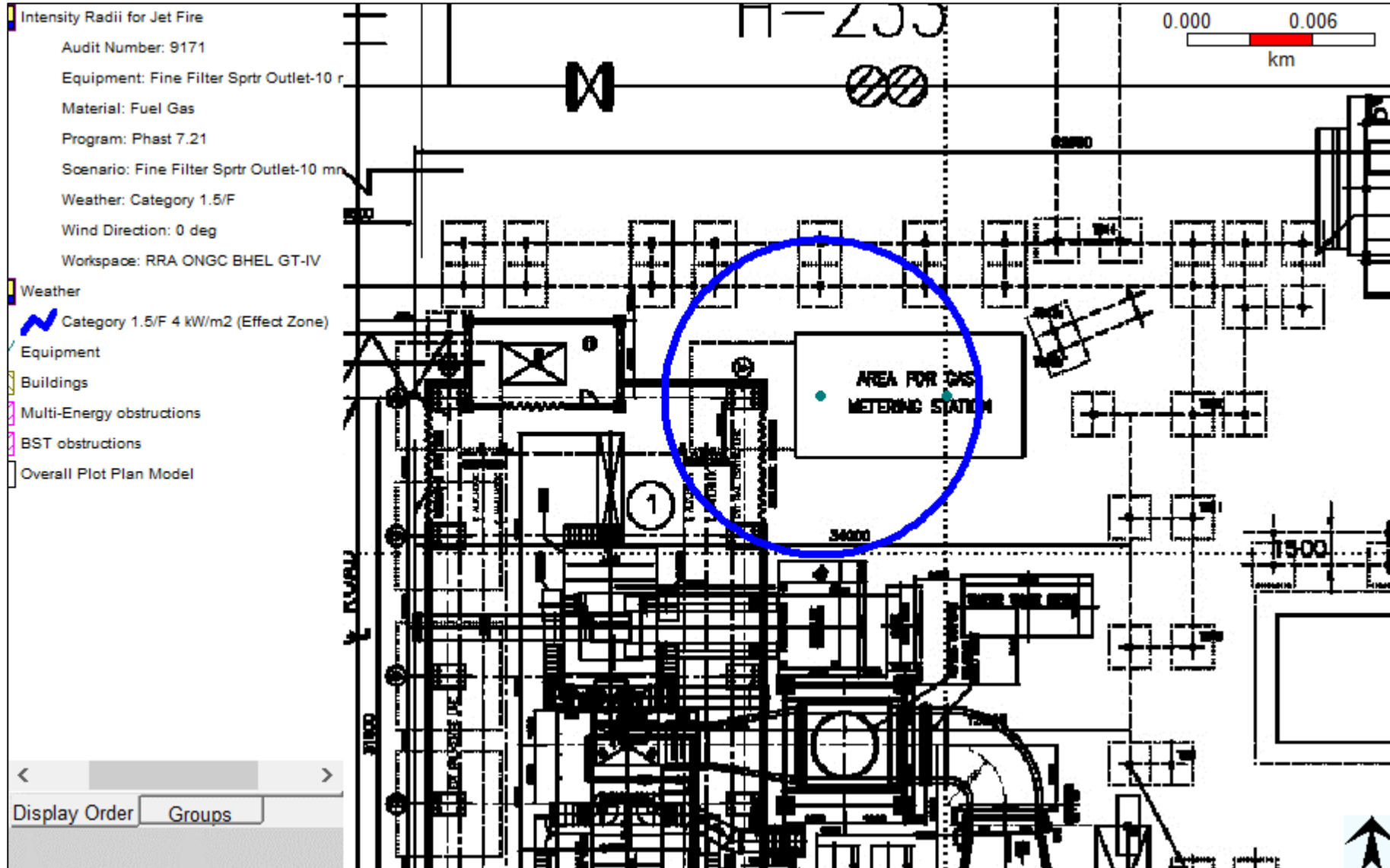


Figure 6.5.8 A: GT-IV: Fine Filter Separator Outlet line- 20 mm leak; Flash Fire Distances (m)

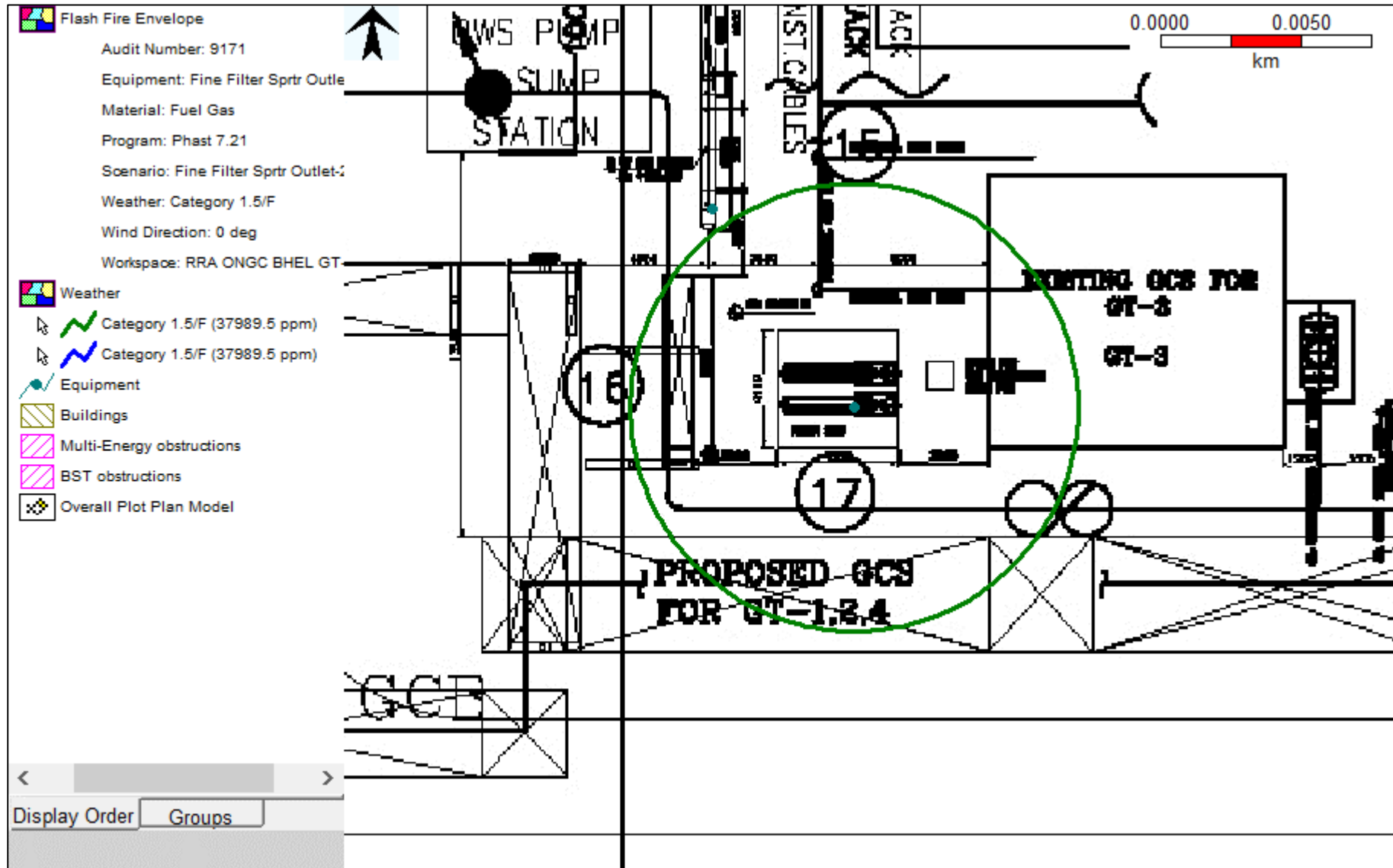


Figure 6.5.8 B: GT-IV: Fine Filter Separator Outlet line- 20 mm leak; Jet Fire Distances (m)

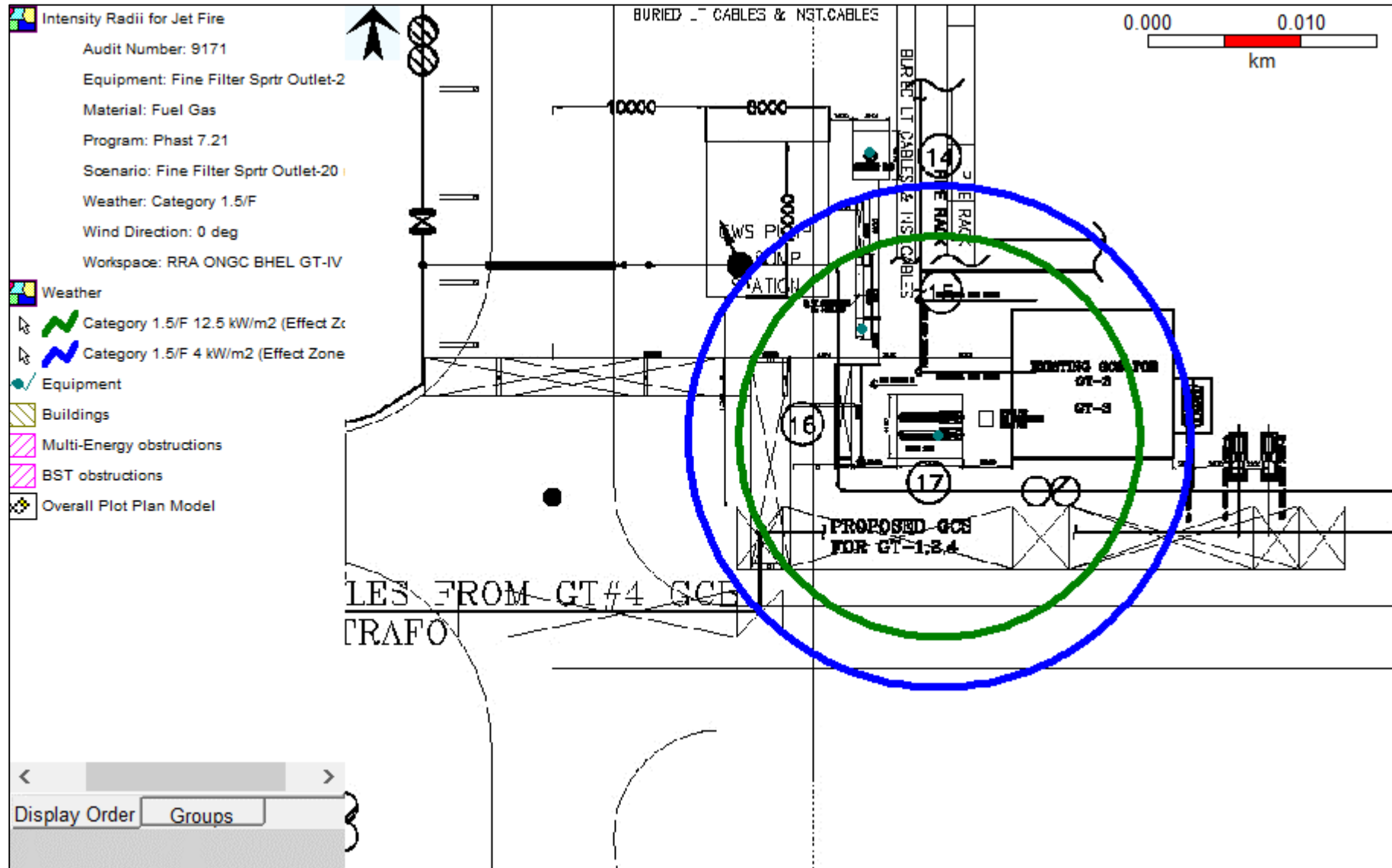


Figure 6.5.8 C: GT-IV: Fine Filter Separator Outlet line- 20 mm leak at Gas Metering Station; Flash Fire Distances (m)

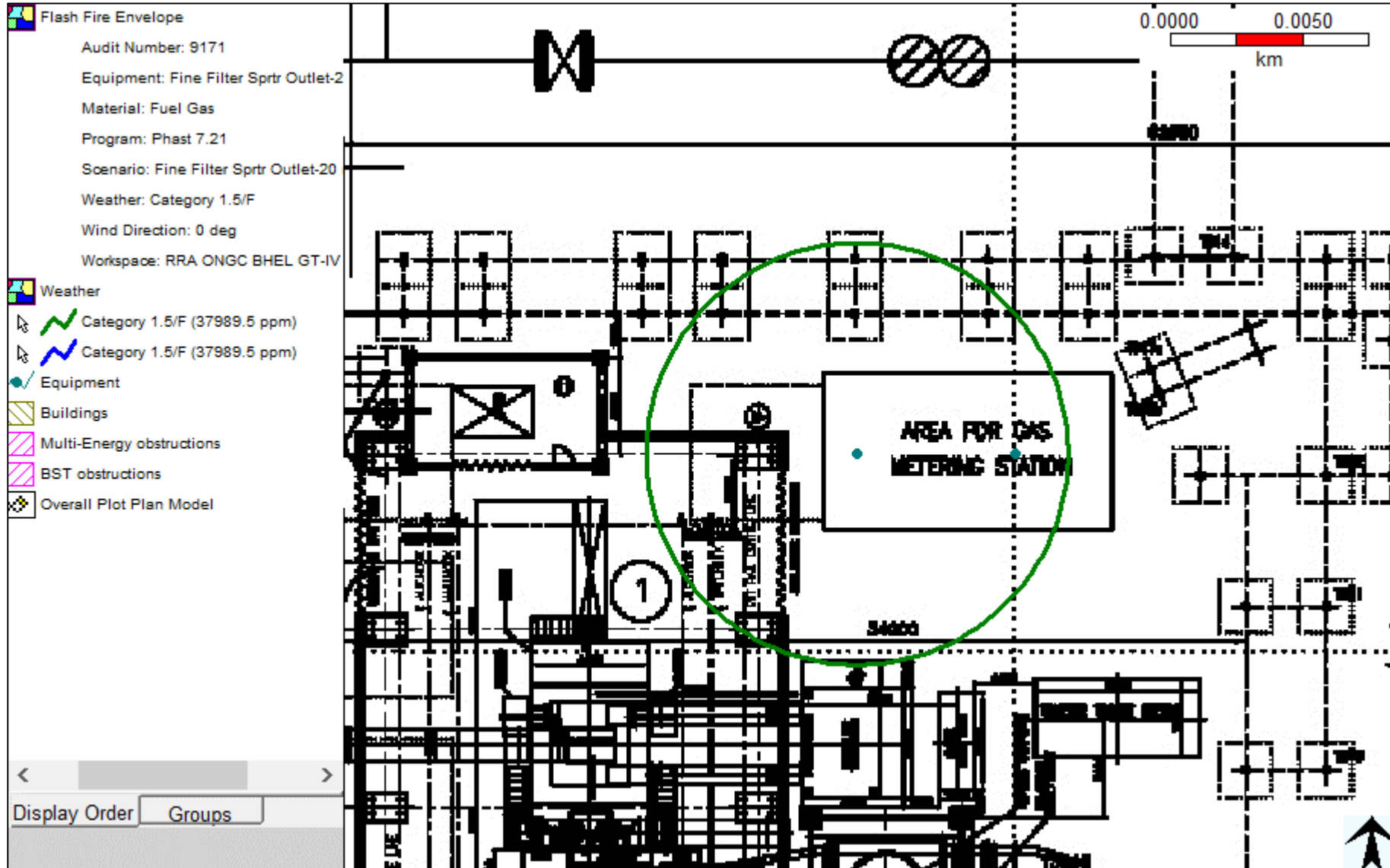


Figure 6.5.8 D: GT-IV: Fine Filter Separator Outlet line- 20 mm leak at Gas Metering Station; Jet Fire Distances (m)

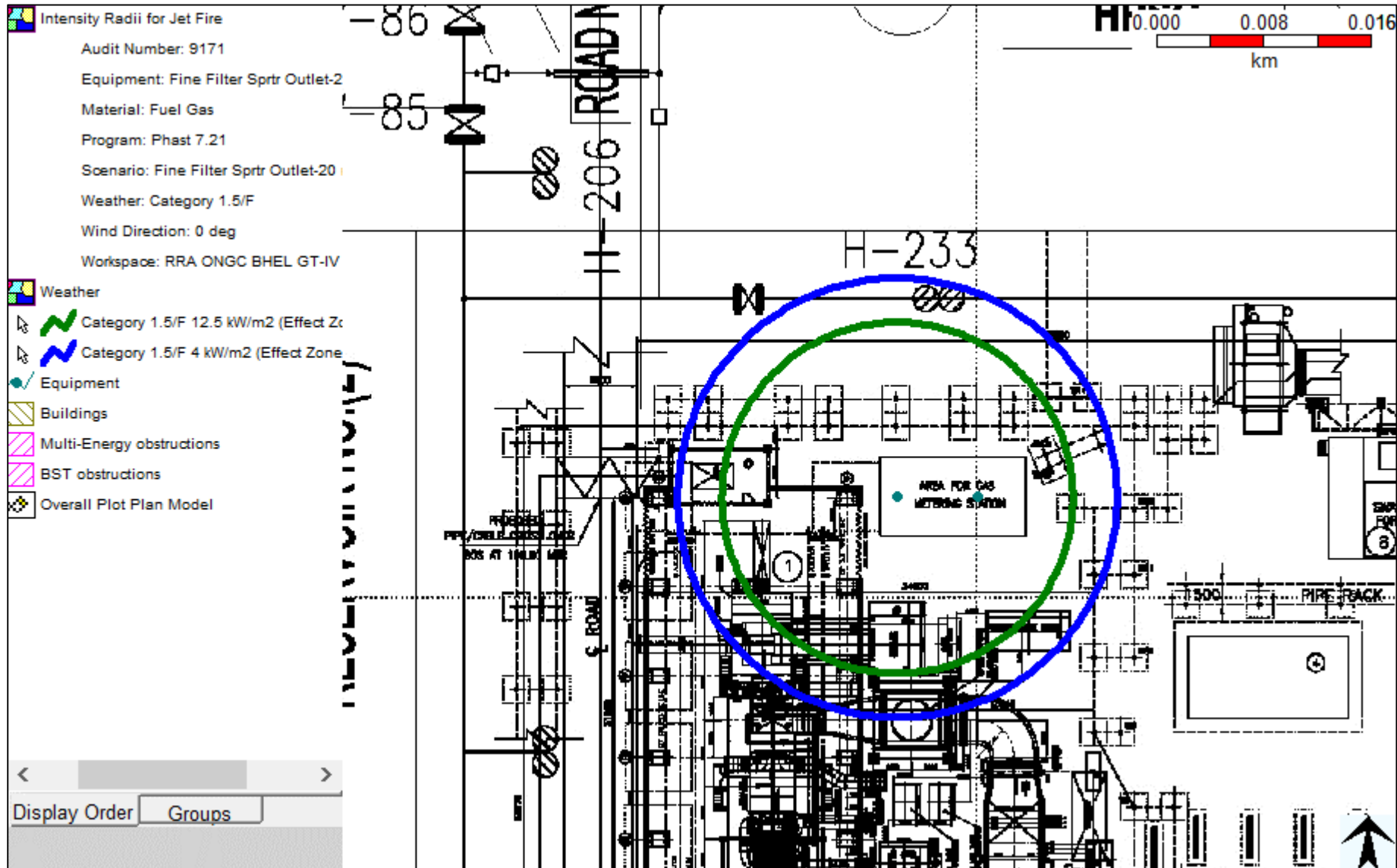


Figure 6.5.9 A: GT-IV: HRSG-4 Inlet line- 10 mm leak; Flash Fire Distances (m)

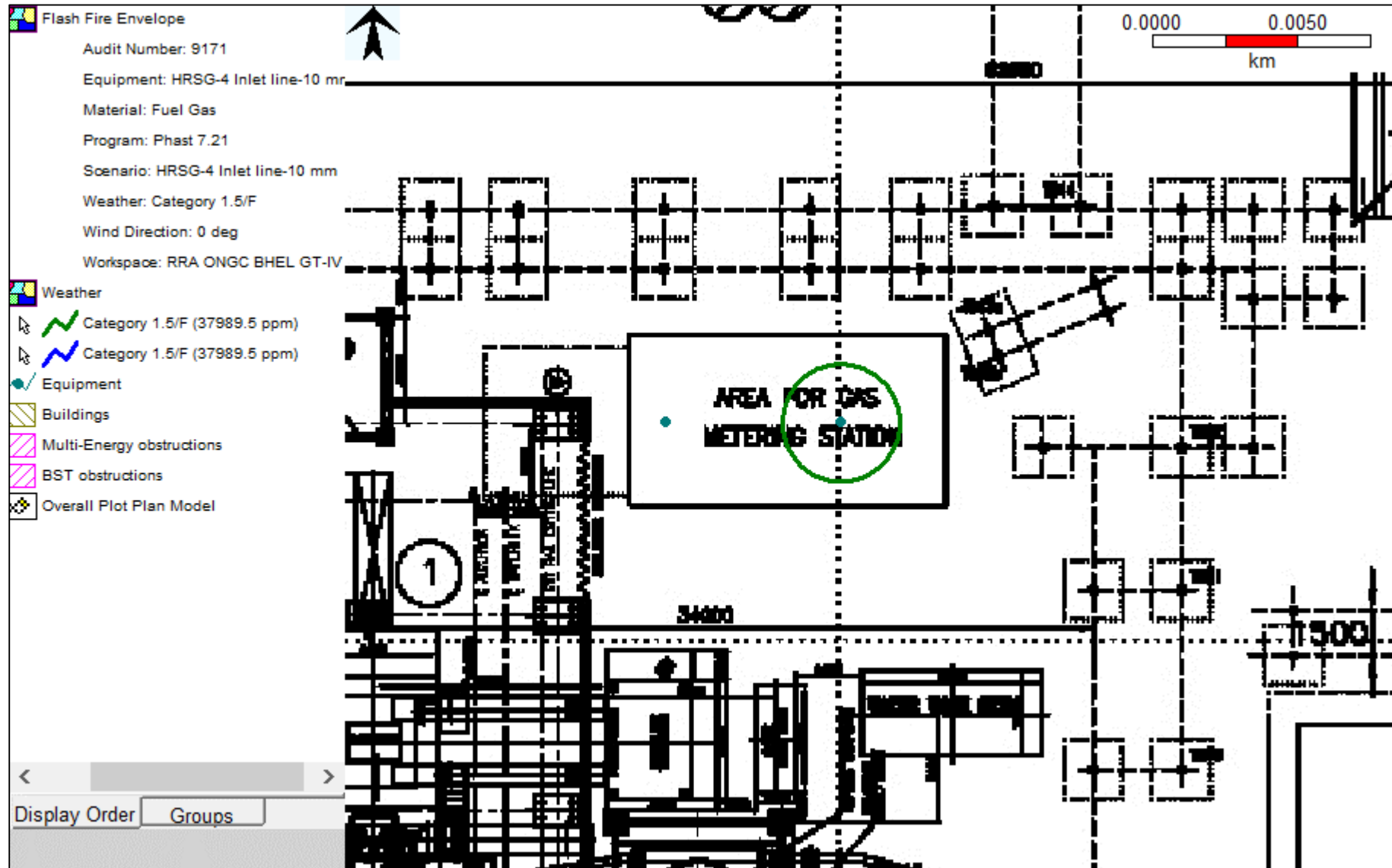


Figure 6.5.10 A: GT-IV: HRSG-4 Inlet line- 20 mm leak; Flash Fire Distances (m)

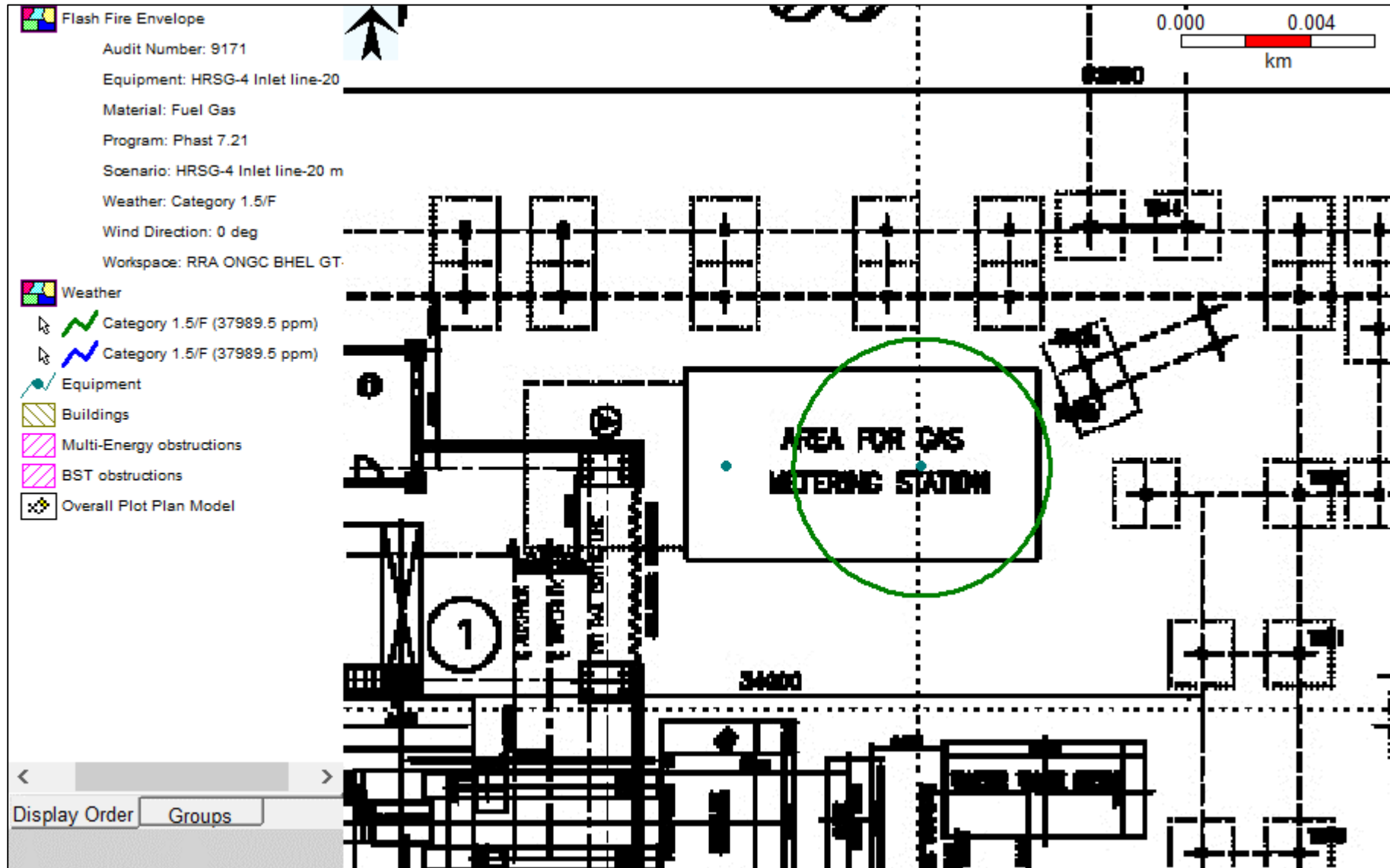
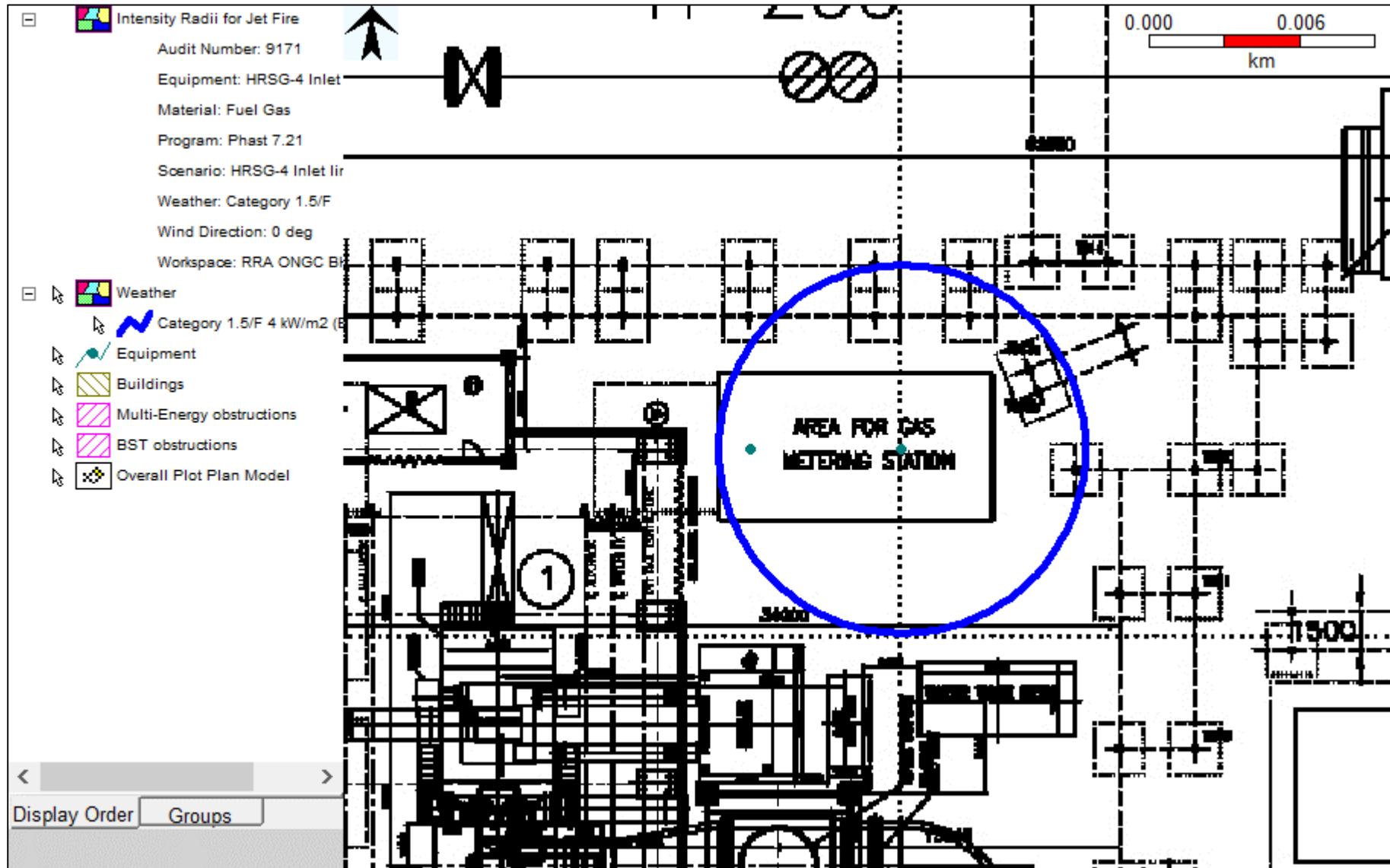


Figure 6.5.10 B: GT-IV: HRSG-4 Inlet line- 20 mm leak; Jet Fire Distances (m)



ADDENDUM TO RAPID RISK ANALYSIS STUDY OF ADDITIONAL CO-GENERATION UNIT GT-IV AT ONGC URAN PLANT



**OIL AND NATURAL GAS CORPORATION LTD.,
URAN**

A	Feb 01 st 19	Issued for Comments	VI/ST	MKJ	RBB
Rev No	Date	Purpose	Prepared By	Reviewed By	Approved By

PREFACE

Engineers India Limited (EIL), New Delhi, has been entrusted by M/s BHEL, Hyderabad for Rapid Risk Analysis Study of Additional Co-Generation Unit GT-IV at ONGC Uran Plant located at Uran in the state of Maharashtra, India.

As a part of the project, Rapid Risk Analysis (RRA) of the Additional Co-Generation Unit GT-IV at ONGC Uran Plant (Doc No.: B235-17-43-RA-0001, Rev. A) was carried out. As per the inclination of M/s ONGC an addendum to the above mentioned report is being issued comprising of the additional RRA work for ERTO Package.

In this perspective, Rapid Risk Analysis Study of the ERTO Package at ONGC Uran Plant is being carried out.

Rapid Risk Analysis study identifies the hazards associated with the facility, analyses the consequences, draws suitable conclusions and provides necessary recommendations to mitigate the hazard/ risk.

This Rapid Risk Analysis study is based on the information made available at the time of this study and EIL's own data source for similar plants. EIL has exercised all reasonable skill, care and diligence in carrying out the study. However, this report is not deemed to be any undertaking, warrantee or certificate.

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This addendum should be referred in conjunction with Rapid Risk Analysis (RRA) of the Additional Co-Generation Unit GT-IV at ONGC Uran Plant (Doc No.: B235-17-43-RA-0001, Rev. A). This addendum is being issued as per the inclination of M/s ONGC for the additional RRA work of ERTO Package.

The scope of work in this addendum is restricted to ERTO package only.

1.2 MAJOR OBSERVATIONS, RECOMMENDATION AND UPDATION

- Consequence outcomes (radiation, explosion & Toxic dispersion) are modelled for Acid Gas line to Heat Recovery Unit (20 mm leak) and it is observed that LFL hazard zone may reach up to a distance of 2 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 59 m from leak source affecting the existing Panel Room and nearby approach road to Guest House.

It is recommended to install Toxic gas detectors with sirens at strategic locations at ERTO Package and traffic to be restricted on nearby approach road to Guest House in event of any leakage in ERTO Package. Also it is recommended to ensure that there is no permanent manned station / continuous human presence in the affected area of H₂S IDLH concentration of 100 ppm.

- Consequence modelling (radiation, explosion & Toxic dispersion) is carried out for Acid Gas line to Heat Recovery Unit (50 mm leak) and it is observed that LFL hazard zone may reach up to a distance of 5 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 128 m from leak source affecting the existing Panel Room, nearby approach road to Guest House, GSU – I, II & III, C2-C3 Plant, C2-C3 Mechanical Store, SRR on northern side, GPG Store.

Hence, it is recommended to install Toxic gas detectors with sirens at strategic locations at ERTO Package. Disaster Management Plan (DMP) & Emergency Response Plan (ERP) to address above scenarios for further mitigation of the risk. It is also recommended to ensure adequate fire-fighting provisions & Breathing Apparatus at ERTO Package.

2 CONSEQUENCE ANALYSIS

Note: Refer Section 3 & 4 for the Consequence analysis hazard distances & graphs

Acid Gas line to Heat Recovery Unit - 20 mm leak: From the event outcome of the selected failure scenario it is observed that LFL hazard zone may reach up to a distance of 2 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 59 m from leak source affecting the existing Panel Room and nearby approach road to Guest House.

Acid Gas line to Heat Recovery Unit - 50 mm leak: From the results of consequence analysis it is observed that LFL hazard zone may reach up to a distance of 5 m from leak source. The 37.5 & 12.5 Kw/m² radiation intensity due to jet fire may not be realized. The 5 & 3 psi blast over pressures may not realize in this leak scenario. The H₂S IDLH Hazard distance may reach upto a downwind distance of 128 m from leak source affecting the existing Panel Room, nearby approach road to Guest House, GSU – I, II & III, C2-C3 Plant, C2-C3 Mechanical Store, SRR on northern side, GPG Store.

3 CONSEQUENCE ANALYSIS HAZARD DISTANCES

Equipment	Failure Case	Operating Conditions		Leak Rate Kg/s	Weather	Flash Fire (m)	Jet Fire (m)			Pool Fire (m)			Blast Over Pressure (m)			IDLH Hazard Dist.
		Temp. (°C)	Press. (Kg/cm ² g)				4 KW/m ²	12.5 KW/m ²	37.5 KW/m ²	4 KW/m ²	12.5 KW/m ²	37.5 KW/m ²	2 psi	3 psi	5 psi	
Acid Gas line to Heat Recovery Unit	20 mm Leak	35	0.2	0.04	1.5 F	2	n/a	n/a	n/a	-	-	-	-	-	-	H ₂ S-59
					2 C	2	n/a	n/a	n/a	-	-	-	-	-	-	H ₂ S-46
					3 D	2	n/a	n/a	n/a	-	-	-	-	-	-	H ₂ S-34
Acid Gas line to Heat Recovery Unit	50 mm Leak	35	0.2	0.24	1.5 F	5	9	n/a	n/a	-	-	-	-	-	-	H ₂ S-113
					2 C	5	9	n/a	n/a	-	-	-	-	-	-	H ₂ S-128
					3 D	5	10	n/a	n/a	-	-	-	-	-	-	H ₂ S-119

4 CONSEQUENCE FIGURES

Figure 4.1 A: ERTO: Acid Gas line to Heat Recovery Unit - 20 mm leak; Flash Fire Distances (m)

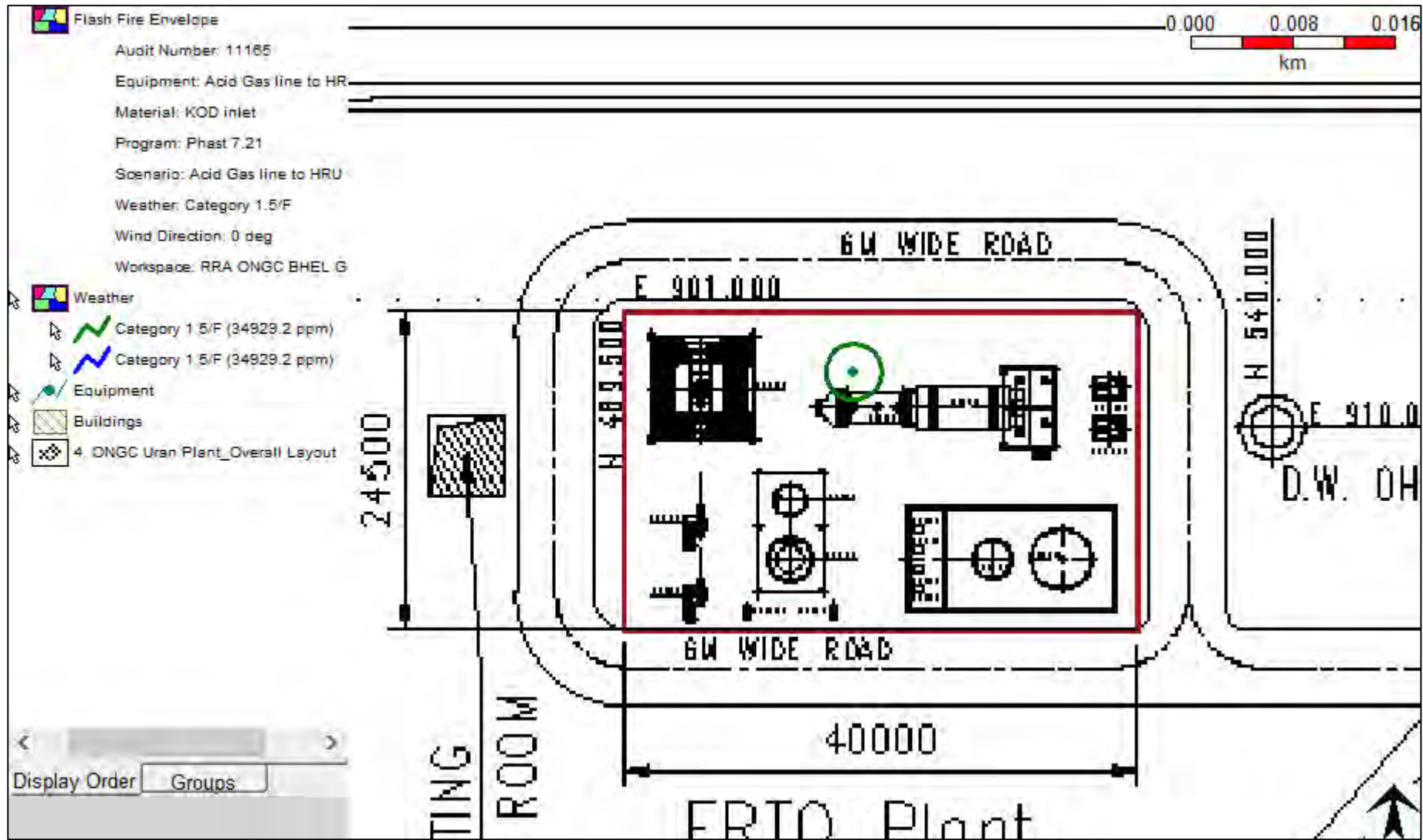


Figure 4.1 B: ERTO: Acid Gas line to Heat Recovery Unit - 20 mm leak; H₂S IDLH Hazard Distances (m)

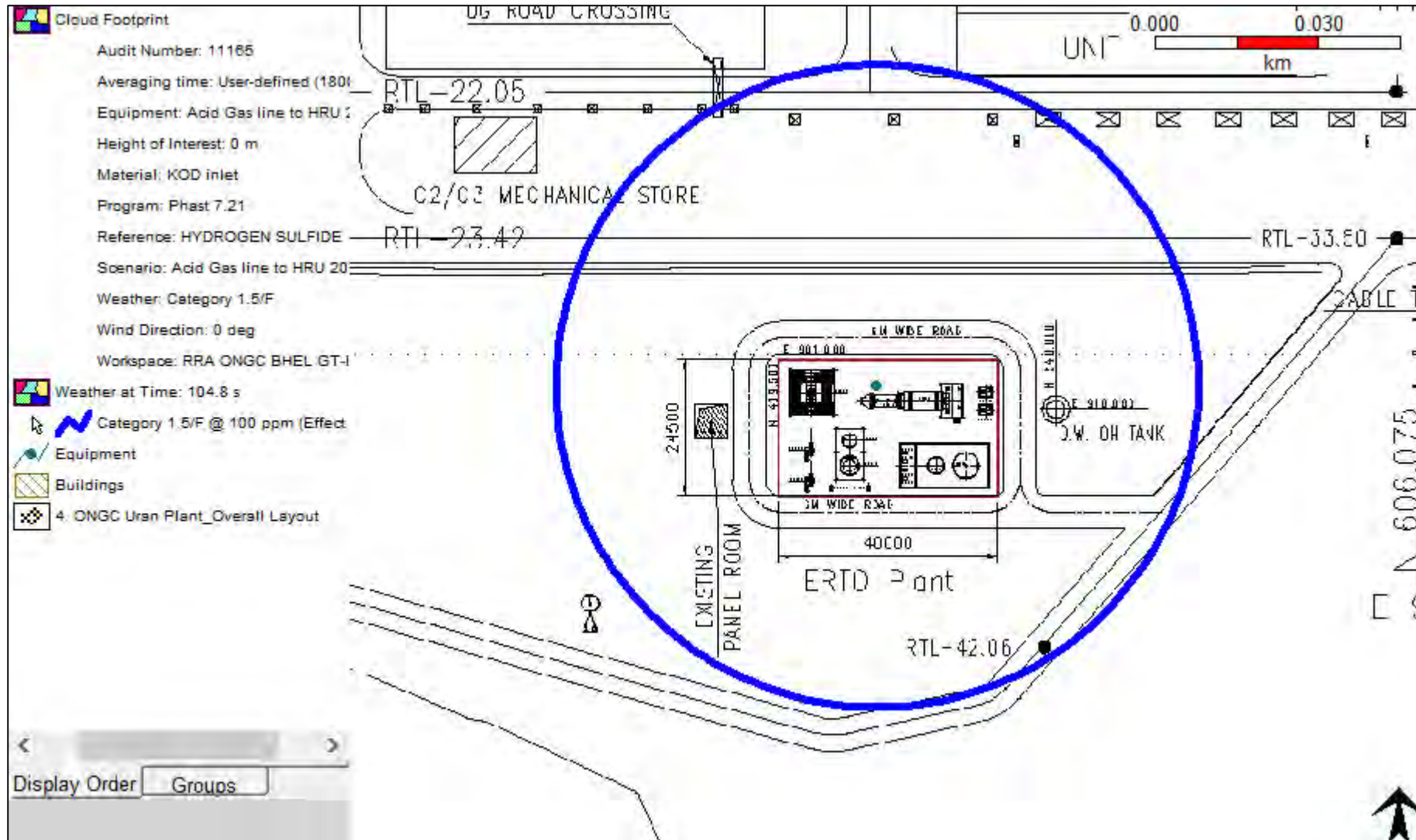


Figure 4.1 C: ERTO: Acid Gas line to Heat Recovery Unit - 20 mm leak; H₂S IDLH Hazard Distances (m)

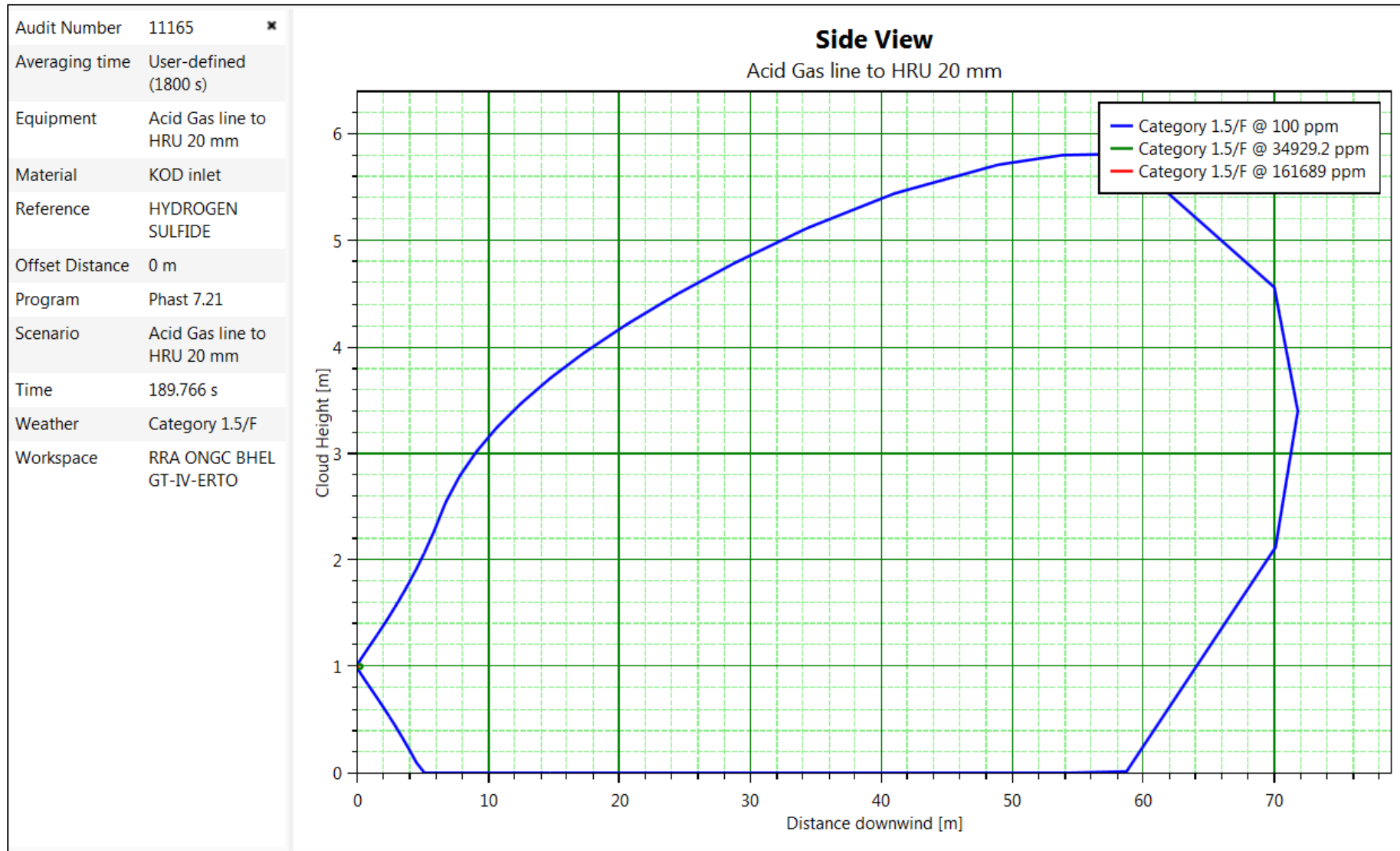


Figure 4.2 A: ERTO: Acid Gas line to Heat Recovery Unit - 50 mm leak; Flash Fire Distances (m)

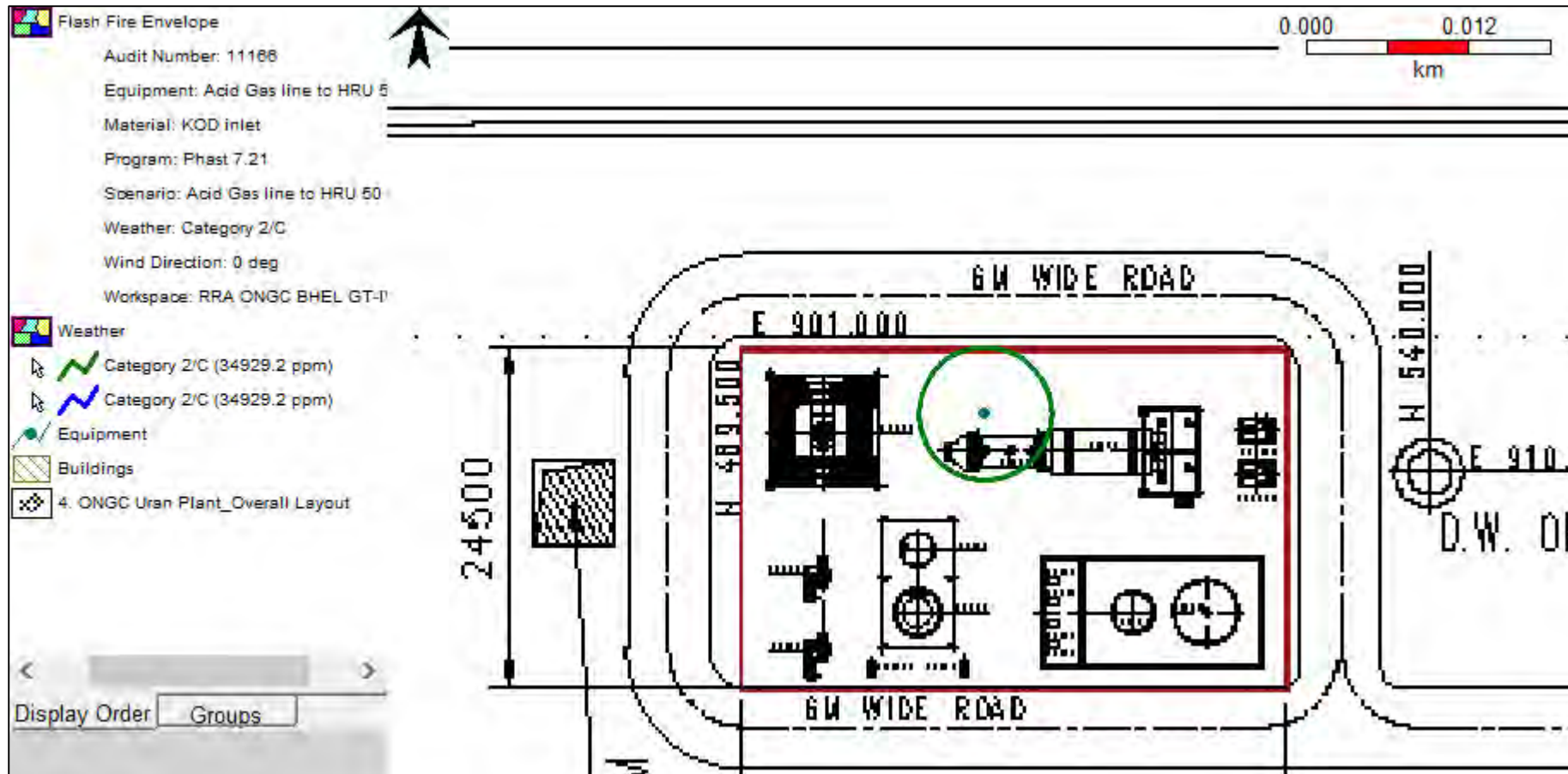


Figure 4.2 B: ERTO: Acid Gas line to Heat Recovery Unit - 50 mm leak; Jet Fire Distances (m)

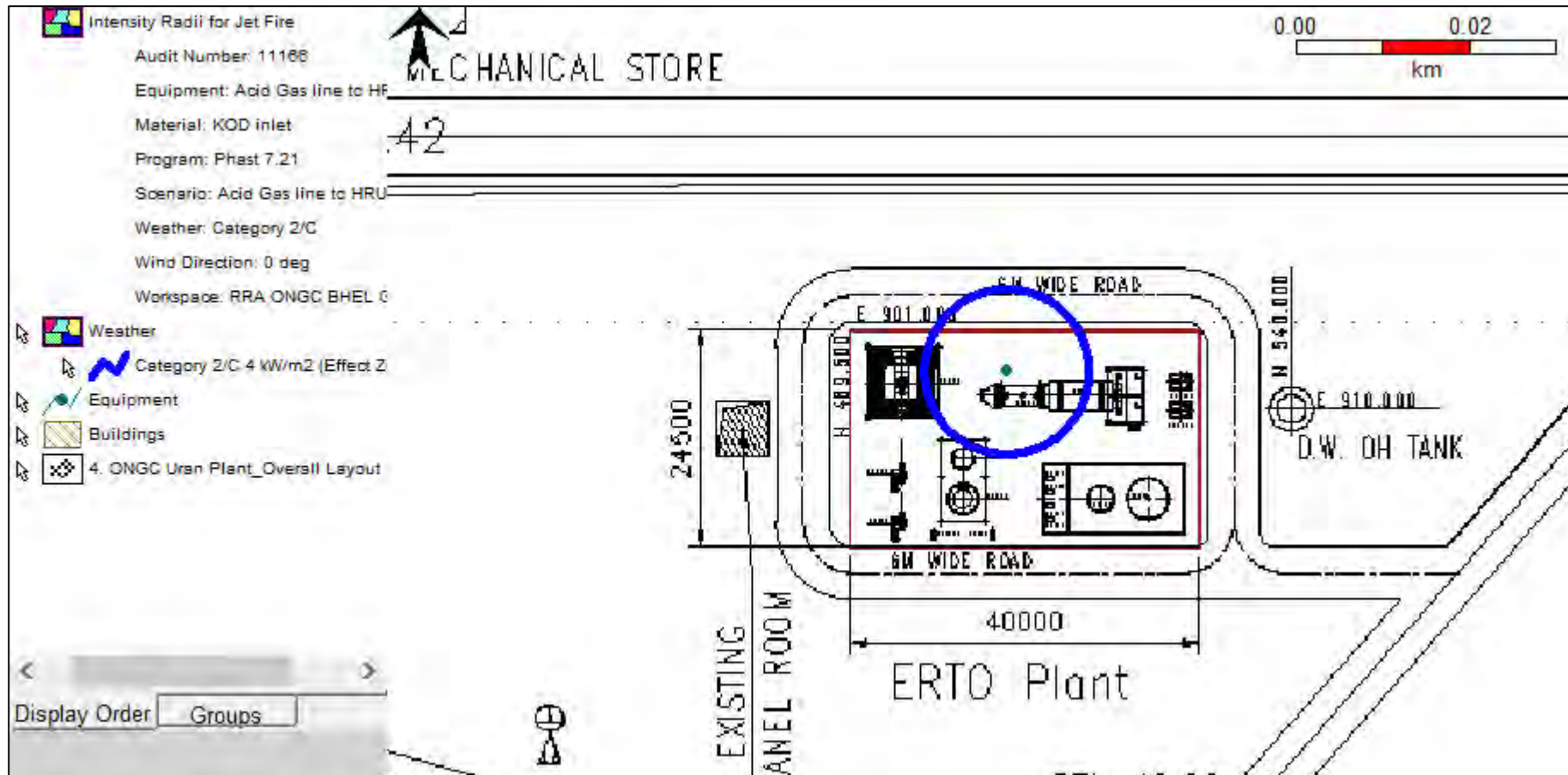


Figure 4.2 C: ERTO: Acid Gas line to Heat Recovery Unit - 50 mm leak; H₂S IDLH Hazard Distances (m)

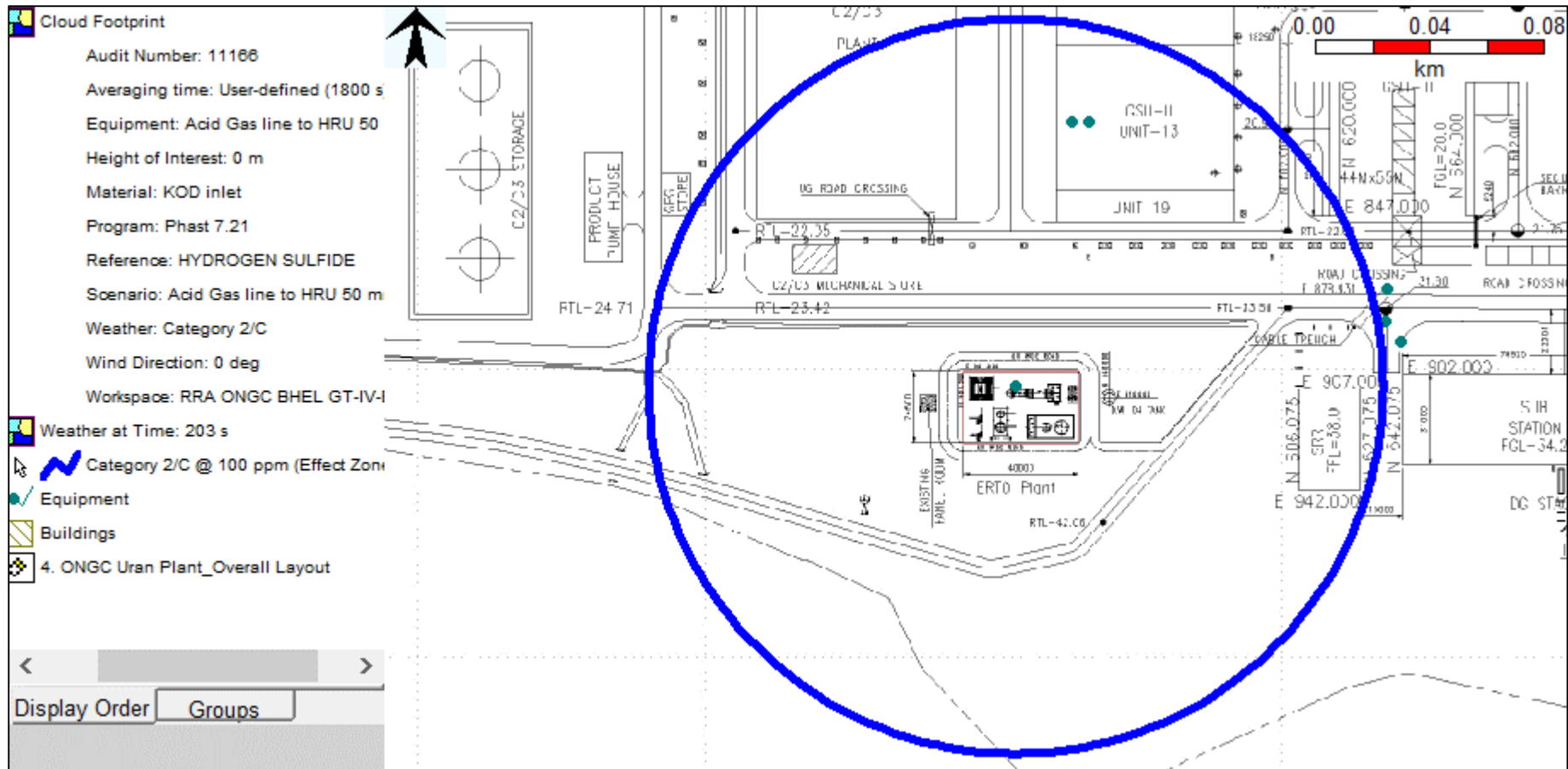
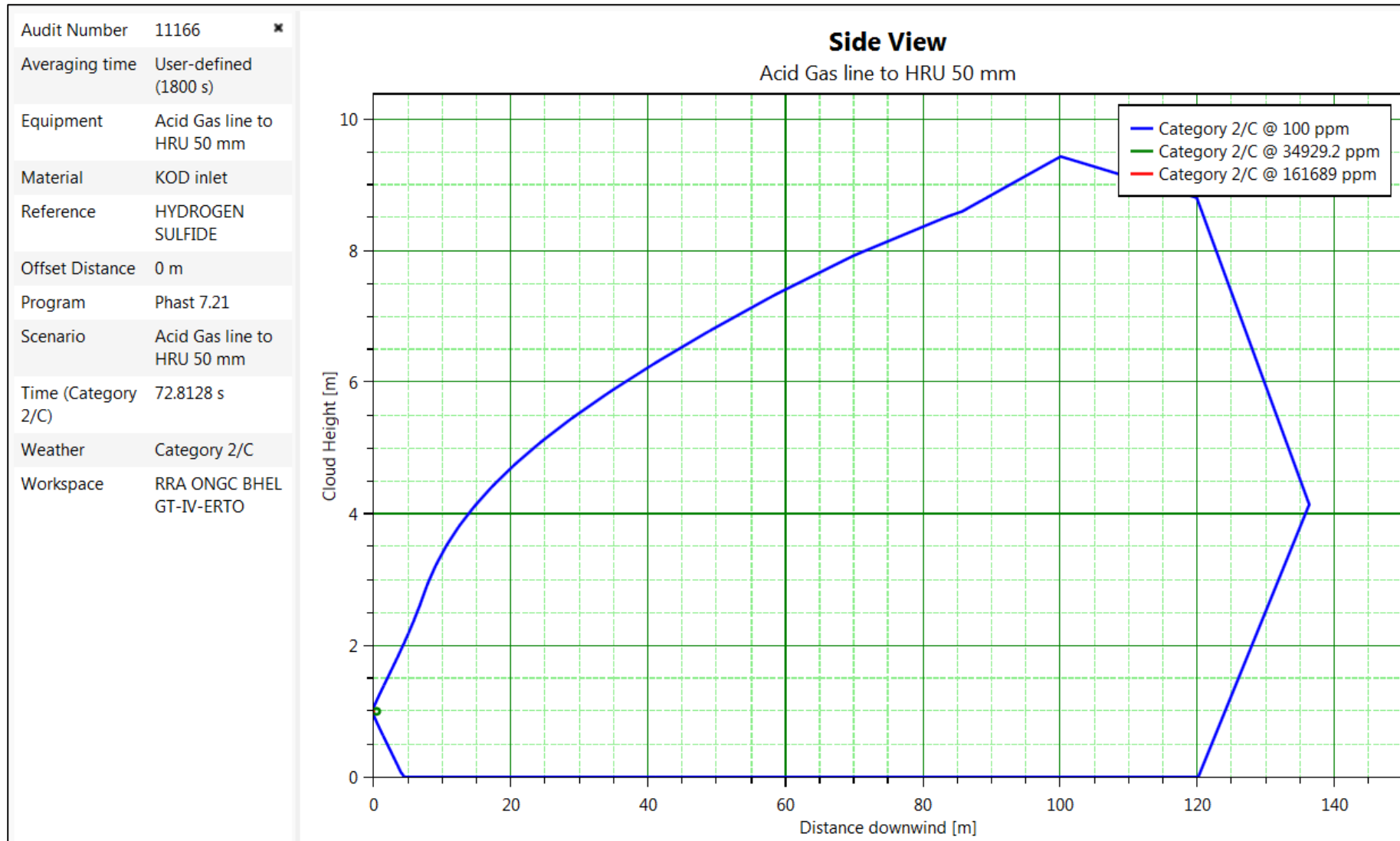


Figure 4.2 D: ERTO: Acid Gas line to Heat Recovery Unit - 50 mm leak; H₂S IDLH Hazard Distances (m)





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