ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR PROPOSED EXPANSION OF ENNORE LNG TERMINAL FROM 5 MMPTA TO 10 MMTPA OF M/S INDIANOIL LNG PRIVATE LIMITED AT ENNORE, CHENNAI, TAMIL NADU

Report No.: B507-1742-EI-2201	February, 2023

Project Proponent:

IndianOil LNG

IndianOil LNG Private Limited (IOLPL)

FILE No.: 11-30/2011-IA.III

Environmental Consultant:

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Engineers India Limited

CERTIFICATE NO.: NABET/EIA/1922/RA 0189_Rev.01

Sector-27 (NABET) & Sector - 6 (a) (MoEFCC)
CATEGORY-A

ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR PROPOSED EXPANSION OF ENNORE LNG TERMINAL FROM 5 MMPTA TO 10 MMTPA OF M/S INDIANOIL LNG PRIVATE LIMITED AT ENNORE, CHENNAI, TAMIL NADU

Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by
0	10.02.2023	ISSUED AS DRAFT REPORT	SM	CP/VS	PKG

DECLARATION BY EXPERTS CONTRIBUTING TO THIS REPORT

Declaration by Experts contributing to the EIA Study Report for proposed Expansion of Ennore LNG Terminal from 5 MMPTA To 10 MMTPA of M/s. Indianoil LNG Private Limited at Ennore, Chennai, Tamil Nadu.

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA which is coming under Category A – "Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passingthrough national parks/ sanctuaries/coralreefs / ecologically sensitive areas includingLNG terminal"; Sector 27 as per NABET Scheme & Category 6 (a) (MoEFCC) as per 2006 EIA Notification.

EIA COORDINATOR:

Name: Parveen Kumar Goel

Signature & Date:
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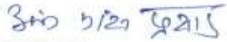
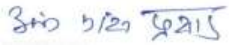
FUNCTIONAL AREA EXPERTS:

Functional Areas	Name of the experts	Involvement (Period & Task)	Signature
SHW	Parveen Kumar Goel	January, 2022 – January, 2023 Identification of storage and disposal of solid and hazardous waste for the proposed plant. Finalization of Environmental Monitoring Plan and Environmental Management Plan.	
WP	Himanshu Gupta	January, 2022 – January, 2023 Review of proposed water requirements for the project, verification and analysis of baseline data, impact assessment, and preparation of environmental management plan for water environment.	
SE	Raja Subbaratna Prasad	January, 2022 – January, 2023 Review of demographic characteristics, and supervision of baseline data collection. Collection and analysis of perception study carried out for the proposed project.	
AP	Jayant Kumar Joshi	January, 2022 – June, 2022 Identification of impacts on AP and suggesting mitigation measures.	

Functional Areas	Name of the experts	Involvement (Period & Task)	Signature
EB	Dr. Chiranjibi Pattanaik	January, 2022 – January, 2023 Site visit, collection and analysis of baseline data on flora and fauna, impact assessment of the study area, preparation of greenbelt development plan and environmental management plan for biological environment.	
HG	Parveen Kumar Goel	January, 2022 – January, 2023 Assessment of ground water sampling results with available secondary data to interpret current conditions.	
AQ	Raja Subbaratna Prasad	January, 2022 – January, 2023 Verification of meteorological data, air quality assessment, air quality impact assessment, Preparation of environmental management plan for the proposed project	
NV	S.V.R. Subramanyam	January, 2022 – January, 2023 Verification of noise and traffic baseline data, impact assessment, Preparation of environmental management plan for noise environment.	
LU	Raja Subbaratna Prasad	January, 2022 – January, 2023 Assessment of soil sampling results with available secondary data to interpret current conditions.	
RH	M.V.A.K. Bhargava Ram	January, 2022 – January, 2023 The Rapid Risk Assessment Report is prepared for the proposed project considering all safety measures.	

Functional Areas	Name of the Team Member	Involvement (Period & Task)	Signature
WP, SHW	Srikumar Malakar	January, 2022 – January, 2023 Assist to Mr. P.K. Goel for: Identification of solid wastes and its mitigation measures. Assist to Mr. Himanshu Gupta for: Identification of impacts on WP and suggesting mitigation measures.	

Functional Areas	Name of the Team Member	Involvement (Period & Task)	Signature
AP	Ravikant Sharma	January, 2022 – January, 2023 Assist to Mr.J.K. Joshi for: Identification of impacts due to air pollution and suggesting mitigation measures.	
SHW	Himanshu Gupta	January, 2022 – January, 2023 Assist to Mr. P.K. Goel for: Identification of solid wastes and its mitigation measures.	

Declaration by the head of the Accredited Consultant Organization/authorized person:

I, Parveen Kumar Goel, hereby, confirm that the above mentioned experts prepared the **EIA / RRA Study for proposed Expansion of Ennore LNG Terminal from 5 MMPTA To 10 MMTPA of M/s. Indianoil LNG Private Limited at Ennore, Chennai, Tamil Nadu.**

I, also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in the statement.

Signature:

Name : Mr. Parveen Kumar Goel
Designation : Head- EIA & Sustainability and Water Department
Name of the EIA Consultant Organization : Engineers India Limited (EIL)

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Annexure No.	Annexure Title
I.	Approved Terms of Reference
II.	Previous EC and EC compliance
III.	Consent for Establishment and Consent for Operation
IV.	Overall Plot Plan Drawing
V.	Rapid Risk Assessment Report
VI.	Coastal Regulation Zone Maps

Compliance to standard TOR (No.11-30/2011-IA.III dated 9th September, 2021)prescribed by MoEFCC for Proposed Project underActivity 6 (a), Category A :

S. No.	Statement	Compliance
1.	Justification of the project.	The gas demand in the Ennore catchment area expected to increase more than 5 MMTPA in 2025-26. Considering this, IOLPL proposes to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA (20 MMSCMD to 40 MMSCMD). This LNG import and regasification terminal of enhanced capacity will supply clean energy (RLNG) and shall spur industrial growth in the states of Tamil Nadu, Andhra Pradesh and Karnataka. The re-gasified LNG will be distributed to power generation plants, fertilizer plants and other industrial units. The gas will also be made available for City gas distribution, including transport sector, commercial sector and for cooking in houses (PNG – Piped Natural Gas). The proposed Ennore terminal expansion project will involve 20 MMSCMD LNG import, storage and Regasification within the existing terminal.
2.	Route map indicating project location.	Indian Oil LNG Import, Storage, and Re-gasification Terminal is situated inside the Kamarajar Port Ltd (KPL), Vallur Post, Thiruvallur District, Chennai – 600120. The proposed expansion will be coming up inside the existing terminal complex. Tentative co-ordinates of proposed facility are Latitude: 13°17'33"N and Longitude 80°20'36"E. The location map and Google map are provided as Fig.-1.1 and Fig.-1.2 in Chapter-1 of EIA report.
3.	Details of land to be acquired. Details of projects vis-à-vis Ecological Sensitive Areas and approvals thereof.	For this proposed project, no additional land is required. All the proposed project facilities are coming up within the existing LNG Terminal complex area. Total area of Ennore LNG terminal is 128 acres.
4.	Project location along with map of 1 km area (500 meters on either side of the pipeline from centerline) and site details providing various industries, surface water bodies, forests etc.	Land use/ land cover map of the project is given Fig.-3.16in Chapter-3 of EIA report.
5.	Analysis of alternative sites and Technology.	For this proposed project, no additional land is required. All the proposed project facilities are coming up within the existing LNG Terminal complex area. Best pipeline route has been adopted based on economic, safety and environmental factors. The existing technology of receiving LNG and regasifying it using glycol water mixture is a proven method of converting LNG to NG. The entire operation is carried out in a closed loop and it provides a safer

S. No.	Statement	Compliance
		and environmental friendly operation.
6.	Location of National Park/Wild life sanctuary/Reserve Forest within 10 km radius of the project.	There is no National Park/Wild life sanctuary/Reserve Forest within 10 km radius of the IndianOil LNG terminal.
7.	Status of clearance from NBWL for pipeline passing through wildlife sanctuary/ Ecological sensitive area.	Not Applicable.
8.	Recommendation of SCZMA /CRZ clearance for the proposed pipeline (if applicable).	The proposed project will require Coastal Regulatory Zone (CRZ) clearance from Tamil Nadu Coastal Zone Management Authority (TNCZMA) and MoEFCC. Institute of Remote Sensing- Anna University, Chennai has carried out CRZ study and preparation of CRZ maps on approved CZMP as per CRZ Notification 2011 for the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu. The High Tide Line (HTL), Low Tide Line (LTL), Ecologically sensitive areas along with setback lines indicated in approved CZMP (Approved CZMP map No: TN 111) prepared as per CRZ Notification 2011 were superimposed on to georeferenced cadastral map to prepare a local level CRZ map at 1:4,000.
9.	Present land use based on satellite imagery for the study area of 10 km radius.	Land use/ land cover map of the project is given Fig.-3.16 in Chapter-3 of EIA report.
10.	Details of applications filed for forest clearance to be obtained for the project for the forest land involved in the project along with details of the compensatory afforestation.	Not Applicable.
11.	Process Description along with Process Flow Diagram.	The proposed configuration to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA (20 MMSCMD to 40 MMSCMD) has the following broad scope of the project facilities: 1. LNG Storage Tanks and associated facilities 2. Regasification facilities including Offsites and Utility Blocks The expansion project will have the following components: ❖ Storage system: LNG storage tanks and Low pressure LNG pumps ❖ High pressure LNG pumps

S. No.	Statement	Compliance
		❖ Vaporizers ❖ Metering system and Final Pressure Adjust ❖ Fuel gas / natural gas system ❖ Relief and drain system Tie-ins will be considered to cover the future expansions. Detailed Process Description of proposed project is provided in Chapter 2 of EIA report.
12.	Details of associated facilities/utilities to be installed.	Utilities and Ancillary Facilities: ➢ Nitrogen Nitrogen is required at the terminal for equipment purging and maintenance purposes. Adequate on site nitrogen generation and storage for liquid nitrogen will be provided at the terminal. ➢ Air Instrument and utility air for use within the terminal are produced on site. Air compressors will provide necessary air for instrument, plant air and Nitrogen. ➢ Power Total power requirement for the proposed project is 12 MW. The additional power requirement will be met from own Captive Power Plant. ➢ Raw Water system For proposed project treated water requirement is 10 m3/hr. The water will be used mainly for service water, fire water make up, horticulture and drinking water. Water will be generated in-house from atmosphere. ➢ Waste and Wastewater Treatment In LNG vaporization scheme normally no liquid, gaseous and solid waste is generated. Only domestic sewage is generated, which is collected and handled through soak-pit/ septic tanks. ➢ Gas Detection, Alarm, Firefighting and ESD Systems A centralized spill, fire and combustible gas alarm and control system will provide input to an information management system. Automatic detection devices, manual alarms and audible and visual signaling devices will be strategically located throughout the terminal. ➢ Communications The terminal will be equipped with up-to-date communications equipment capable of maintaining contact with the LNG carriers scheduled to offload at the terminal and with the standby tugs. ➢ Buildings Switchgear/MCC Building - will house switchgear, motor control centers, panel boards, UPS, batteries and battery charges, lighting transformers, PLC panels for switchgears, MCCs, generator control panels and

S. No.	Statement	Compliance
		other equipment. Detailed Utilities and Ancillary Facilities description of proposed project is provided in Chapter 2 of EIA report.
13.	Details of water consumption and source of water supply, waste water generation, treatment and effluent disposal.	For proposed project treated water requirement is 10 m3/hr. The water will be used mainly for service water, fire water make up, horticulture and drinking water. Water will be generated in-house from atmosphere. In LNG vaporization scheme normally no liquid, gaseous and solid waste is generated. Only domestic sewage is generated, which is collected and handled through soak-pit/ septic tanks. From the proposed project, generation of industrial liquid wastewater generation is not envisaged.
14.	Detailed solid & Hazardous waste generation, collection, segregation, its recycling and reuse, treatment and disposal.	From the proposed project, no solid waste generation is envisaged.
15.	Total cost of the project along with total capital cost and recurring cost/annum for environmental pollution control measures.	Estimated cost of the Expansion Project is approximately Rs. 3,400 Crores. The total estimated budget for implementation of EMP measures is Rs. 40 Lakhs as capital cost and Rs. 14 Lakhs as recurring cost per annum. Break up of capital and recurring cost/annum for environmental pollution control measures is given in section 10.9 of Chapter-10.
16.	Site-specific micro-meteorological data for temperature, relative humidity, hourly wind speed and direction and rainfall for one season at one location.	Micro-meteorological data is provided in section 3.2.1 of Chapter 3.
17.	Ambient air quality monitoring within the study area of 500 m along the pipeline route and around the pumping station and delivery station for PM2.5, PM10, SO2 , NOx, CO, HC, VOC for one season(Non Monsoon) taking into account the pre-dominant wind direction at the representative locations covering population zone and sensitive receptors including reserved forests.	All Ambient air quality monitoring data are provided under section 3.2.2 of Chapter-3.
18.	Determination of atmospheric inversion level and assessment of ground level concentration of pollutants. Air quality modelling	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

S. No.	Statement	Compliance
	for proposed project.	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. There will be no release of SO_2, PM_{10} and $PM_{2.5}$ from the proposed project. Only small quantity of NO_X emission is envisaged due to combustion of gaseous fuel in GTG. Hence, Ground Level Concentration (GLC) prediction modelling for only NOx has been only carried out. The incremental NOx GLC (maximum 24 hr) due to operation of proposed facilities is predicted as 4.6 µg/m3. Details are provided under section 3.2.2 of Chapter-3.
19.	Water monitoring to be conducted including surface & ground water for one season (Non Monsoon).	Water monitoring for surface and ground water is carried out for one season and all monitoring results are provided under section 3.4 of Chapter-3.
20.	Soil sample analysis within the study area for one season (Non Monsoon).	Soil sample analysis within the study area for one season is carried out for one season and all monitoring results are provided under section 3.5 of Chapter-3.
21.	Noise Monitoring will be taken up for one season (Non Monsoon).	Noise Monitoring is carried out for one season and results are provided under section 3.3 of Chapter-3.
22.	Demography & socio-economics of the study area.	Demography & socio-economics of the study area are provided in section 3.6 of Chapter 3.
23.	Ecological features (terrestrial & Aquatic) of the study area for one season (Non Monsoon).	Ecological features of terrestrial of the study area for one season are provided in section 3.7 of Chapter 3.
24.	Assessment of impact on air, water, soil, solid/hazardous waste and noise levels.	Assessment of impact on air, water, soil, solid/hazardous waste and noise levels is provided in Chapter 4.
25.	A detailed note on method to be used for crossing road, nalla, stream, rivers, railway line etc.	Not Applicable.
26.	Air pollution control measures proposed for the effective control of gaseous emissions within permissible limits.	• Ensuring preventive maintenance of equipment. • Regular monitoring of air polluting concentrations. • Developing/ maintaining peripheral green belt in the proposed plant premises. • Leak Detection and Repair (LDAR) will be in place to mitigate any fugitive emission from storage etc.
27.	Details of proposed preventive measures for leakages and accident.	Rapid Risk Assessment study was carried out and all leakages & accident scenario are taken care. RRA study report is attached as **Annexure-V**.
28.	Risk assessment including Hazard identification, Consequence Analysis, Risk Assessment and preparation of Disaster Management Plan as per Regulations.	Rapid Risk Assessment study was carried out and the same is attached as **Annexure-V.**

S. No.	Statement	Compliance
29.	Corrosion Management of Pipeline	Not Applicable.
30.	Details of proper restoration of land after laying the pipelines.	Not Applicable.
31.	Details of proposed Occupational Health Surveillance program for the employees and other labour.	Details of proposed Occupational Health Surveillance program for the employees and other labour: • Display of Occupational Health & Safety Policy; • Periodic medical examinations of all workers working with the hazardous process; • Reporting of all incidence and accidents by Accident & Incidence Reporting System as per ERDMP; • Investigation of all incidence and accidents by Investigation Report System; • Review of first aid facility& training for First Aid by displaying information at work place ; • Awareness of Occupational Hazards & General health promotional in workers by conducting lectures for occupational health hazards in annual planner at training center.
32.	Detailed Environment Management Plan (EMP) with specific reference to Energy conservation and natural resource conservation, details of air pollution control system, water & wastewater management, monitoring frequency, responsibility and time bound implementation plan for mitigation measure will be provided.	Detailed Environment Management Plan is provided in Chapter-10 of this EIA Report.

इंजीनियर्स इंडिया लिमिटेड
(भारत सरकार का उपक्रम)
एक नवरत्न कम्पनी
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A Navratna Company
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Certificate of Plagiarism Check

Title of EIA Report	ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR PROPOSED EXPANSION OF ENNORE LNG TERMINAL FROM 5 MMPTA TO 10 MMTPA OF M/S INDIANOIL LNG PRIVATE LIMITED AT ENNORE, CHENNAI, TAMIL NADU
Name of Accredited Organization	Engineers India Limited (EIL)
Unique Identification Number	B507-1742-EI-2201 (Rev. No. 0)
Name of EIA Coordinator (EC)	Mr. Parveen Kumar Goel
Name of the Software	Plagiarism Checker X
Days of Check	Friday, February 10, 2023
Time of Check	14:30 hrs

Declaration by the Head of the accredited consultant Organization/ Authorized Person:

I hereby Certify that this EIA report has been evaluated using Online Software i.e. **Plagiarism Checker X**. The report produced has been analyzed by the system and based on it, I Certify that the EIA report is in accordance with good scientific practice.

Date and Sign of EIA Co-coordinator : February 10, 2023

Name : **Mr. Parveen Kumar Goel**

Designation : **EIA Co-ordinator**

Date and Sign of Head of Accredited Organization : February 10, 2023

Name of the EIA Consultant Organization : **Engineers India Limited (EIL)**

NABET Certificate No. and Validity Date : NABET/EIA/1922/RA 0189_Rev.01 dated 21.12.2020

CHAPTER – 1

INTRODUCTION

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) is the largest commercial undertaking in India is engaged in the business of refining, transportation and marketing the Petroleum products and Regasified LNG (RLNG). IOLPL, a Joint Venture company of Indian Oil Corporation Limited, was incorporated in the year 2015 under the Companies Act, 2013 for implementation of Ennore LNG Import, Storage, and Re-gasification Terminal Project. The project is having 5 MMTPA capacity with provision to expand up to 10 MMTPA inside the Kamarajar Port (formerly known as Ennore Port), Chennai. IOLPL commenced construction of the terminal in 2015 and completed/commenced operations in 2019. Ennore LNG Terminal is the first LNG terminal on the eastern coast of India.

The gas demand in the Ennore catchment area expected to increase more than 5 MMTPA in 2025-26. Union Government of India has set a vision to make India a gas-based economy and intends to increase gas share in energy mix from present 6% to 15% by 2030. With Government of India's focus to extend City Gas Distribution networks to 70% of India's population for the use of gas as transportation fuel as well as kitchen fuel and also to expand existing national gas grid in the country, the demand of natural in the country will see an upward trend and thereby requiring higher capacities for import, storage and re-gasification of LNG. Considering this, IOLPL proposes to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA(20 MMSCMD to 40 MMSCMD).This LNG import and regasification terminal of enhanced capacity will supply clean energy (RLNG) and shall spur industrial growth in the states of Tamil Nadu, Andhra Pradesh and Karnataka. The re-gasified LNG will be distributed to power generation plants, fertilizer plants and other industrial units. The gas will also be made available for City gas distribution, including transport sector, commercial sector and for cooking in houses (PNG – Piped Natural Gas). The proposed Ennore terminal expansion project will involve 20 MMSCMD LNG import, storage and Regasification with some provision of Tie-ins for future expansion.

In this regard, IOLPL submitted proposal (vide Proposal No.: IA/TN/IND2/226614/202109) dated 02 Sep 2021 to obtain Terms of Reference (TOR). Ministry of Environment, Forests and Climate Change (MoEFCC) prescribed standard TOR (No.11-30/2011-IA.III dated 9thSeptember, 2021) for preparing environment impact assessment report and obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006 under activity "6(a) Oil & gas transportation pipeline (crude and refinery/petrochemical products), passing through national parks / sanctuaries /coral reefs /ecologically sensitive areas including LNG Terminal". The proposed project will also require Coastal Regulatory Zone (CRZ) clearance.

IOLPL has entrusted the task of preparation of Environmental Impact Assessment (EIA) and Rapid Risk Assessment (RRA) studies of proposed Ennore Terminal expansion to M/s Engineers India Limited (EIL). EIL is an accredited consultant for carrying out EIA studies by Quality Council of India for activity: "6(a) Oil & gas transportation pipeline

(crude and refinery/petrochemical products), passing through national parks / sanctuaries /coral reefs /ecologically sensitive areas including LNG Terminal".

1.1 BRIEF DESCRIPTION OF THE PROJECT

This existing terminal receives imported LNG through LNG carriers / ships at a dedicated LNG Berth already constructed inside Kamarajar Port and stores the same at cryogenic temperature of (-) 162 Degree Celsius and near atmospheric pressure i.e. 180 mbar in 2 nos of above ground full containment type LNG tanks of 180000 cubic meter capacity each. Full containment tanks are the safest tanks for LNG storage. LNG stored at (-) 162deg C in the tank is pumped with the help of In-tank Low Pressure pumps at 10 bar to flood the suction of High-Pressure pumps, which in turn pressurise LNG to 90 bar. LNG is then converted into gas in the Shell and Tube type Vaporisers by indirect heating with room temperature water-glycol mixture. The glycol is mixed with the water so that water should not freeze and stop circulating through the equipment. The regasified LNG (RLNG) at 90 bar pressure is then sent to the metering & send-out pipeline for transportation to various customers through a cross country pipeline network. The proposed project envisages expansion of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA.

As part of the expansion work, 2 additional Full Containment type LNG storage tanks of 180,000 cubic meter capacity each, High Pressure LNG Pumps, Vaporizers, Atmospheric Air Heaters, Captive Power Plant, etc. will be installed along with allied piping, civil, instrumentation and electrical jobs apart from requisite utilities and ancillary facilities. Natural Gas is lighter than air and hence in case of any leakage, it will go up in to the atmosphere. Piping will be fabricated with fully welded joints avoiding flange connections, thereby reducing the risk of leakages. Boil-off gas generated in the Terminal will be converted to liquid LNG with the help of re-condenser and sent back into the system. Safety and integrity of the facilities is ensured through gas detection/ leak detection and alarm system installed in the Terminal. The expansion project will be built in line with the international codes and standards in terms of construction and safety.

1.2 NEED FOR THE PROJECT

At present, natural gas share in India is only 6% of the total energy basket of India as compared to world average of 24%. As gas is efficient and environment friendly fuel, it is aptly termed as green fuel and so preferred fuel of the century. There is a wide gap between gas demand and supply due to inadequate domestic gas discoveries and production in the present scenario. The future outlook for domestic gas production estimated by various agencies is not sufficient to meet the growing demand and the country remains gas deficient. Hence the only way to meet the growing demand of gas is to import LNG and use it. Southern states, particularly Tamil Nadu, Puducherry and some parts of Karnataka & Andhra Pradesh are starving for power due to inadequate gas supplies. Various market studies indicated that there is sufficient demand for LNG in the region and particularly major demand centers are in the vicinity of Chennai.

Moreover, in a bid to move to gas-based economy, Government of India (GoI) has been focusing on increasing the gas share in the energy mix to 15 percent from the current 6 percent by the year 2030. There is also a push to establish national gas grid and has already notified unified tariff structure with the aim to reduce the cost of natural gas for users far away from the source of natural gas and / or LNG terminal. This would act as a catalyst in boosting the consumption of natural gas in the country. The demand for RLNG in the catchment area of Ennore LNG Terminal, is expected to increase beyond 5 MMTPA by 2025-26. The additional gas demand in the catchment area would be on account of new gas based Power Plants and switching of existing Power Plants to RLNG. There will also be an increase in RLNG demand due to development of CGD networks in the districts of Chennai, Tiruvallur, Kancheepuram, Cuddalore, Vellore, Chittoor, etc. as well as Puducherry.

There is also a potential demand of LNG from the neighbouring countries viz. Myanmar, Bangladesh & Sri Lanka through LNG break bulking operations and offering ancillary services like gassing up & cooling down, LNG bunkering, etc. Considering the time and efforts required for construction of new storage tanks and the requirement of enhanced regasification capacity of the Terminal, Ennore LNG terminal has planned for the Expansion Project to cater to additional gas demand of the customers in Ennore catchment area in future.

Expansion of gas infrastructure would improve the quality of life of local people by bringing in more direct / indirect employment opportunities. It is envisaged to generate some direct and indirect employments for local people. New industries / power plants planned to be set up based on gas will benefit from this terminal and hence likely to cause less pollution than that of coal based power plants.

1.3 PROJECT SCHEDULE AND COST

For expansion of the Terminal, no additional land is required since the additional LNG storage tanks as well as regasification facilities will be located within the existing premises of the Ennore LNG Terminal. The estimated cost of the Expansion Project is approximately Rs. 3,400 Crores. The Expansion Project is expected to be completed and commissioned in 54 months.

1.4 PROJECT PROPONENT

1.4.1 Address of the Project Proponent

The correspondence address of the project proponent is:

CEO
Indian Oil LNG Private Limited
Indian Oil Bhavan, 8th Floor
139, Nungambakkam High Road
Chennai - 600 034

Landline: 044-27964559
Email: ceo@indianoillng.in

1.4.2 Particulars of EIA Consultant

The EIA consultant is Engineers India Limited. The complete address for correspondence is given below:

Mr. Parveen Kumar Goel,
Head : EIA, Sustainability & Water Department,
Engineers India Limited,
EIL Office Complex,
Sector-16, On NH-48,
Gurugram – 122001, Haryana,
Email: pk.goel@eil.co.in
Tel: 0124-2891235

1.5 NEED & SCOPEOF THE EIA STUDY

As per project/activity 6(a) of Schedule of EIA Notification 2006, for setting up any New LNG Terminal or it's Expansion, Environmental Clearance (EC) is required EIA Notification, 2006. Hence, the project will also require Coastal Regulatory Zone (CRZ) clearance from Tamil Nadu Coastal Zone Management Authority (TNCZMA) and MoEFCC. Hence, an EIA study report along with Environmental Management Plan (EMP) is needed to be submitted to all statutory bodies. Therefore, EIA study has been carried out for the proposed project.

1.5.1 Project location

Indian Oil LNG Import, Storage, and Re-gasification Terminal is situated inside the Kamarajar Port Ltd (KPL), Vallur Post, Thiruvallur District, Chennai – 600120. The proposed expansion will be coming up inside the existing terminal complex. Tentative co-ordinates of proposed facility are Latitude: 13°17'33"N and Longitude 80°20'36"E. The Ennore Port accesses the vast Manali Industrial area, two thermal power plants and has about 3300 acres of its own land. Along with the Tamilnadu Industrial development Corporation (TIDCO) it has an access to another 4000 acres of land around the port area. The location is fairly uninhabited with barren salt marshes all around and therefore ideally located to handle various cargo to cater to the Manali Industrial area and TIDCO Petrochem Park proposed adjoining the port. The port has excellent connectivity with the hinterland through the National Highways and well connected by railway network. The Port is connected to the Southern Railway network and a BG railway siding exists upto North Chennai Thermal Power Station (NCTPS).

The port is well connected by State and National highways. The road connectivity is obtained through NH4, NH5 and NH45. A network of internal roads connects railway sidings, stack yards and Tankage areas. Southern Railway connects Ennore port to all

parts of the country. There is a railway yard in which wagons are received and interchanged. Ennore Railway Station is approx. 10 Km from the terminal.

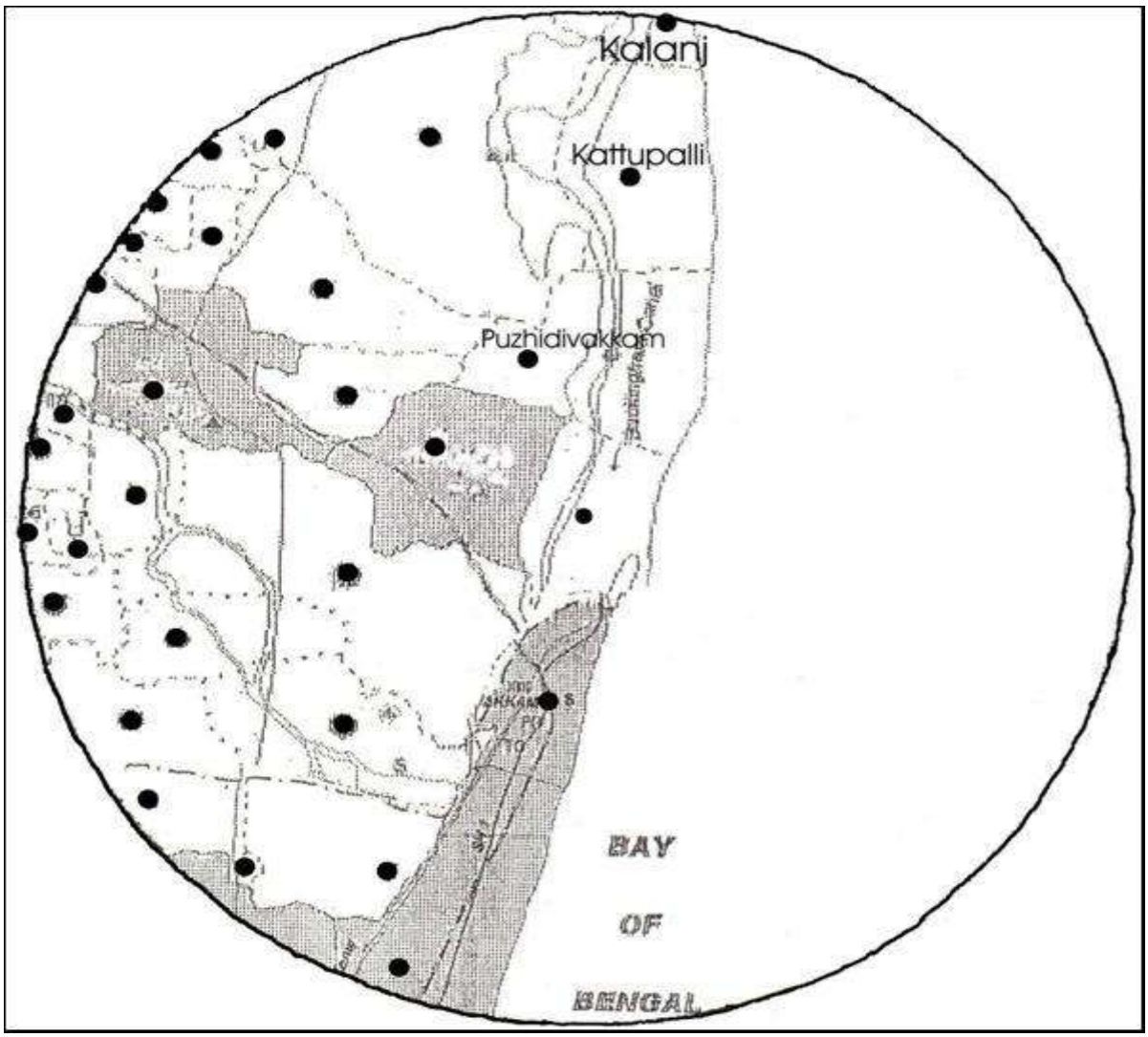


Fig. 1.1: Location Map of IOLPL Ennore LNG Terminal

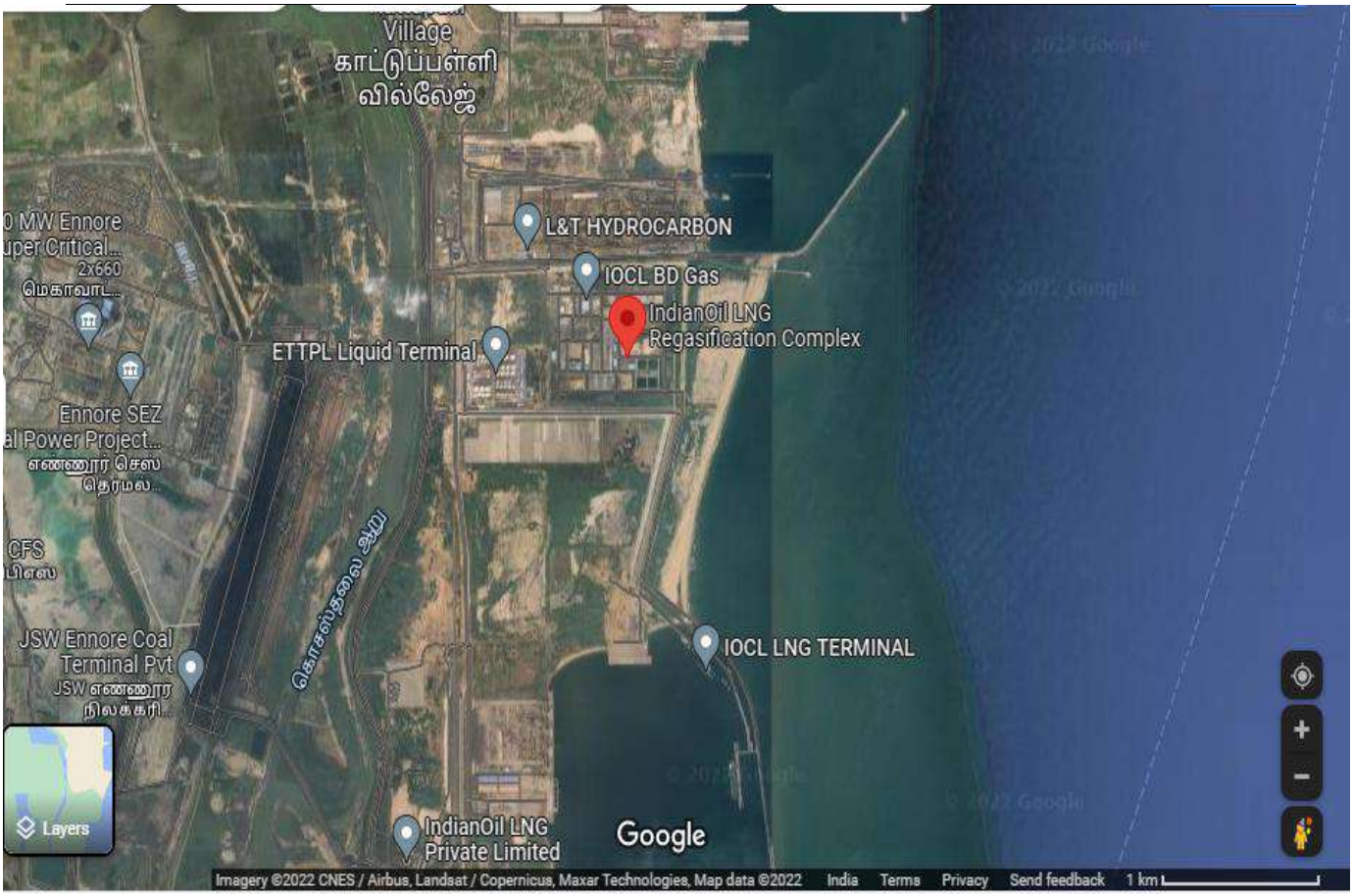


Fig. 1.2: Google map of the IOLPL Ennore LNG Terminal

1.5.2 List of industries around the project

Thiruvallur district is one of the fastest developing districts in Tamil Nadu in terms of Industrial Development. The district has many leading industries like CPCL Refineries, Madras Fertilizers, Manali Petro Chemicals, MRF, Ashok Leyland, TI Cycles, Britannia India Ltd, Parry India Ltd and Hindustan Motors. It also boasts of the Ennore Thermal Power Station and the Avadi Tank Factory. The District has 16 Industrial Estates, all are in operation.

1.5.3 Environmental Sensitivity

There is no National Park, Wildlife Sanctuary, historic monuments around 10 Km radius of the Indianoil LNG terminal. Nearest Railway Station: Attipattu Pudunagar (5 km), nearest airport: Chennai (50 km), nearest big city: Chennai (25 km). Environmental Sensitivity table is provided below.

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	There is no natural forest land, reserve forest or ecological sensitive areas in the vicinity of the project site.
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration.	No	The land identified for the project is the developed land parcels inside operating Terminal and no terrestrial fauna species are available in the area. Bird species found in the proposed development area are common urban birds such as the cuckoo, cattle egret, etc.
4	Inland, coastal, marine or underground waters	Yes	Bay of Bengal, Kosasthalaiyar River
5	State, National boundaries	No	
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	
7	Defense installations	No	
8	Densely populated or built-up area	No	
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	No	
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	No	
11	Areas already subjected to pollution or environmental damage. (those where existing legal environmental standards are exceeded)	No	

S.No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	No	

1.6 SCOPE OF EIA

The scope of the present EIA study includes detailed characterization of existing status of various environmental components viz., air, noise, water, land, soil, traffic, flora fauna, meteorological and socio-economic conditions in 10 Km project area.

The scope of study broadly includes:

- Establish the baseline environmental status of the study area utilizing three months baseline data (March, 2022–May, 2022 by M/s. J.P. Test & Research Centre).
- Assessment of the present status of air, water, noise, traffic, land, soil, flora-fauna and socio-economic components of environment based on field surveys and available literature.
- Identification of likely impacts of various activities proposed to be undertaken during construction as well as operation phases of the project.
- Prediction and evaluating the impact of activities carried out during the construction and operational phases of the project.
- Preparation of an Environmental Management Plan (EMP), which is to be adopted for mitigation of adverse impacts and improving the environmental quality.
- Risk assessment for storage& regasification operations.

1.7 CONTENTS OF THE EIA REPORT

The report has been divided into 12 chapters and presented as follows:

Chapter-1.0: Introduction	This chapter provides background information of the 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 Project activities, process being adopted, sources of pollution and control thereof.
Chapter-3.0: Description of the Environment	This chapter presents the methodology and findings of field studies undertaken to establish the baseline conditions.
Chapter-4.0:	This chapter details the inferences drawn from the Environmental

Anticipated Environment Impacts and mitigation measures	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: Analysis of Alternative Site	This chapter provides Alternative analysis of site & evaluation of the different choices available to achieve a particular project management objective. It is an analytical comparison of different factors like operational cost, risks, effectiveness as well as the shortfalls in an operational capability.
Chapter-6.0: Environment Monitoring Program	This chapter provides technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules)
Chapter-7.0: Additional Studies	This chapter covers Risk involved in the proposed facilities, storages and utilities and Occupational Health and Safety. It also includes Coastal Regulatory Zone (CRZ) study report carried out as part of this Project.
Chapter-8.0: Project Benefits	This chapter presents the details of Local area development programmes that shall be implementing in local vicinity during Construction & Operation phases of the Project.
Chapter- 9.0: Environmental Cost Benefit Analysis	This chapter presents the details of Environmental Cost Benefit analysis; if recommended at the scoping stage.
Chapter-10.0: 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 mitigation 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-11.0: Summary & Conclusion	This will constitute the summary of EIA Report.
Chapter-12.0: Disclosure of Consultants	This chapter contains the list of various experts engaged in preparing the EIA report along with brief introduction of the consultant company.

1.8 MOEFCC APPROVED TERMS OF REFERENCE FOR EIA

IOLPL submitted proposal (vide Proposal No.: IA/TN/IND2/226614/202109) dated 02 Sep 2021 to obtain Terms of Reference (TOR). Based on the review of the documents submitted by the IOLPL, Ministry of Environment, Forests and Climate Change (MoEFCC) prescribed standard TOR (No.11-30/2011-IA.III dated 9th September, 2021) for preparing environment impact assessment report and obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006 under activity

"6(a) Oil & gas transportation pipeline (crude and refinery/petrochemical products), passing through national parks / sanctuaries /coral reefs /ecologically sensitive areas including LNG Terminal". The approved TOR is attached as **Annexure-I.**

1.9 EARLIER ENVIRONMENTAL CLEARANCE AND THEIR COMPLIANCE

The existing Ennore Terminal has obtained environmental and CRZ clearances. Project proponent is regularly submitting its compliance report to regional office of MoEFCC at Chennai. All environment clearances accorded from MoEFCC are given in brief in below mentioned Table 1.2.

Table 1.2: Previous Environmental Clearances issued to Ennore Terminal from MoEFCC

Sl No	Projects/ Units	Environment Clearance document	Date	Compliance
1	Environmental and CRZ Clearance for setting up of LNG Terminal at Ennore, Tamil Nadu by M/s. Indian Oil Corporation Ltd.	F.No. 11-30/2011-IA.III	10.02.2014	Complied
2	Transfer of Environmental Clearance for setting up of LNG Terminal at Ennore, Tamil Nadu from M/s. Indian Oil Corporation Ltd. to M/s. Indian Oil LNG Private Ltd.	F.No. 11-30/2011-IA III Pt. File	22.04.2016	Complied
3	Setting up of LNG Terminal at Ennore, Tamil Nadu by M/s Indian Oil LNG Private Ltd - Amendment in Environmental and CRZ Clearance	F.No.11-30/2011-IA.III	10.10.2018	Complied

A certified copy of the latest monitoring report from Regional Office, MoEFCC (Chennai) on the status of compliance of conditions stipulated in all environmental clearances is attached in **Annexure II**. CTE and latest CTO are attached as **Annexure-III**.

CHAPTER – 2

PROJECT DESCRIPTION

2.0 INTRODUCTION

This existing terminal receives imported LNG through LNG carriers / ships at a dedicated LNG Berth already constructed inside Kamarajar Port and stores the same at cryogenic temperature of (-) 162 Degree Celsius and near atmospheric pressure i.e. 180 mbar in 2 nos of above ground full containment type LNG tanks of 180000 cubic meter capacity each. Full containment tanks are the safest tanks for LNG storage. LNG stored at (-) 162deg C in the tank is pumped with the help of In-tank Low Pressure pumps at 10 bar to flood the suction of High-Pressure pumps, which in turn pressurize LNG to 90 bar. LNG is then converted into gas in the Shell and Tube type Vaporisers by indirect heating with room temperature water-glycol mixture. The glycol is mixed with the water so that water should not freeze and stop circulating through the equipment. The regasified LNG (RLNG) at 90 bar pressure is then sent to the metering & send-out pipeline for transportation to various customers through a cross country pipeline network. The proposed project envisages expansion of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA.

As part of the expansion work, 2 additional Full Containment type LNG storage tanks of 180,000 cubic meter capacity each, High Pressure LNG Pumps, Vaporizers, Atmospheric Air Heaters, Captive Power Plant will be installed along with allied piping, civil, instrumentation and electrical jobs apart from requisite utilities and ancillary facilities. Piping will be fabricated with fully welded joints avoiding flange connections, thereby reducing the risk of leakages. Boil-off gas generated in the Terminal will be converted to liquid LNG with the help of re-condenser and sent back into the system. Safety and integrity of the facilities is ensured through gas detection and alarm system installed in the Terminal. The expansion project will be built in line with the international/ Indian codes and standards in terms of construction and safety. For expansion of the Terminal, no additional land is required since the additional LNG storage tanks as well as regasification facilities will be located within the existing premises of the Terminal at Kamarajar Port, Ennore, Tamilnadu.

2.1 OVERVIEW OF PROJECT

The Ennore LNG terminal is currently designed considering the following sendout:

- Normal – 20 MMSCMD
- Minimum – 8 MMSCMD
- Design – 24 MMSCMD (20% overdesign)

The terminal is designed to provide sendout gas at the battery limit at the following pressures:

- Normal operating pressure: 88 barg
- Minimum operating pressure: 80 barg
- Maximum pressure: 95 barg

The send out temperature at normal operating pressure will be minimum $5^{o}C$.

The proposed configuration to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA (20 MMSCMD to 40 MMSCMD) has the following broad scope of the project facilities:

1. LNG Storage Tanks and associated facilities
2. Regasification facilities including Offsites and Utility Blocks

The expansion project will have the following components:

- Storage system: LNG storage tanks and Low pressure LNG pumps
- High pressure LNG pumps
- Vaporizers
- Metering system and Final Pressure Adjust
- Fuel gas / natural gas system
- Relief and drain system

Tie-ins and plot plan space will be considered to cover the future expansions. In below sections, detailed descriptions have been provided.

2.2 PROPOSED PROCESS DESCRIPTION

The process description for various process systems provided in following sections.

2.2.1 Storage system: LNG Storage tanks and low pressure LNG Pumps

Two (2) full containment storage tanks of having capacities of 180,000 m3 each have been considered for the LNG reception and storage. Unloading operation from carriers can be done to a single tank or simultaneously to both tanks. This section consists of two (2) tanks and four (4) Low Pressure LNG Pumps per tank. Each storage tank and its group of LP LNG pumps (considering one as spare) are able to provide the normal / maximum Terminal send out. The tanks are provided with two filling lines to achieve an optimum mixing between LNG with different composition. One line sends LNG to the top of the inner tank and the other line sends LNG to the bottom. The filling mode depends on the quality of the stored and the unloaded LNG. When unloaded LNG is heavier than stored, the LNG from carrier is sent to the top of the inner tank. Lighter LNG from carrier is sent to the bottom of the tank. The top loading will be carried out using a piping connection in to the top of the tank with a splash plate. The bottom loading will be performed using a standpipe inside the tank with a down-comer pipe. Tanks will store the LNG, and the space at the tank top shall hold the vapours generated due to the tank heat leak (Boil off Gas, BOG). LNG from LP LNG Pumps is collected from both storage tanks in the LP header to send the LNG to the Recondenser and to the truck loading area. LP LNG pumps are protected from low flow by a kick backline under flow control. BOG is handled with the existing BOG Compressors to be returned to the jetty during ship unloading and to be recovered, used as fuel gas and recondensed with LNG.Tanks normal operating pressure varies from 100 to 250 mbarg, depending on Terminal operation mode(ship unloading or no ship unloading). Tank pressure is maintained with BOG compressors. An absolute pressure controller acting over compressor capacity is included in both tanks to maintain the operating pressure of the

tanks. Two gauge pressure controllers are also included in both tanks to add high pressure NG in case of low pressure or to send the BOG to the flare in case of high pressure in the system. For emergency situations pressure relief valves and vacuum breaker valves are installed on the top of each storage tank to ensure the tank integrity. Alarms and shutdown devices have been incorporated to provide maximum safety for the tanks.

2.2.2 High Pressure LNG Pumps

LNG from LP pumps, via recondenser and by-pass line, is pumped by the High Pressure LNG pumps to the vaporizers under flow control. The pressure of this stream is increased up to the pressure level required for the natural gas transmission system (95 barg max) by these pumps. Minimum flow protection facilities (kick-back line) have been provided in order to protect the pumps. Pump suction barrel pressure is floating with the recondenser.

2.2.3 Vaporizers

LNG at adequate pressure is routed from the high pressure pumps to the vaporizers under flow control according to Terminal send out. The LNG is heated and vaporized from -135ºC to 7ºC approximately. The vaporization system configuration consists of six (6) Shell and Tube Vaporizers (STV's) which use water– ethylene glycol mixture (WEG) as intermediate fluid in a close loop. Ethylene glycol content is 36 wt. % to avoid freezing inside vaporizer. The STV's are vertical type with process fluid (LNG) by the tube side and heating medium (WEG) by the shell side. To avoid heating medium freezing, the cold end of the exchanger is in co-current flow and the rest in counter-current flow. There are, therefore, two hot fluid inlets to the shell and a single outlet. The LNG enters the exchanger at the bottom and NG exits at the top. The Ambient Air Heaters (AAHs) are forced draft type used for heating water-ethylene glycol mixture from the vaporizers outlet.

2.2.4 Metering System and Final Pressure Adjust

Natural gas, before sent to the natural gas transmission system, needs to be metered. Fiscal metering is required using ultrasonic flow meters. The pipeline pressure will vary due to different changes in demand, therefore, a pressure control valve shall be provided downstream of the metering station in order to ensure a steady Terminal send out operation. The range of operating pressure in the grid is from 80 barg to 95 barg. In case of high pressure, pressure controller can reduce the LNG flow rate to vaporizer in order to limit the NG sent to the grid.

2.2.5 Fuel Gas/ Natural Gas System

Fuel gas is required for minor consumptions such as flare header purging, flare pilot lightning, etc. Compressed BOG is used as fuel gas and NG from vaporizers is used as back-up. Additionally, natural gas is required to be supplied as fuel for the Captive Power Plant located within the LNG Terminal. This natural gas is provided from the send out header upstream of the metering system.

2.2.6 Relief and Drain System

Relief philosophy is based on sending the warm relieves (gas) to the BOG header (tank vapour space).Warm relieves coming from recondenser and compressors pressure safety valves are directed to the BOG header. Due to the large volume of the system, no pressurization is expected and the vapour relief would not discharge to flare. A flare system within the Terminal is considered as final destination in case of overpressure of the BOG system. The flare stack is the final disposal element that uses combustion to do it in a safe way. The flare system receives mainly controlled discharges from tanks and other equipments and depressurization of the plant for maintenance and for fire emergency protection. Relief from safety valves of major equipments such as tanks and vaporizers will be sent to atmosphere at safe location.

A dedicated LNG drain system is provided. In general, major and minor systems and thermal relief valves discharge to this system. LNG drain system consists in a drain header that collects different drainages and thermal expansion liquid relieves. Drainages from high pressure equipment are provided with restriction orifice to limit the flow rates and protect drain system piping from high pressures. Drain header discharges to an underground horizontal vessel with boot. This drain drum is balanced with the BOG header. It is emptied pumping out the liquid to the storage tanks using a vertical motor-driven submersible- type centrifugal pump mounted inside the boot of the drain vessel. Some systems are not drained to the dedicated drain system. The unloading arms and the jetty head are drained to the storage tanks through the unloading lines using the jetty knockout drum. The compressor suction knockout drum is drained directly to the storage tanks using the compressor drain vessel. Finally, some systems, such as LP pumps wells, individual LP pumps discharge lines and truck loading area, are drained directly to the storage tanks.

2.2.7 Recirculation Lines

When large LNG lines are not in operation, ambient heat leak into these LNG filled lines may produce vaporization. Therefore, it is a good practice to circulate LNG through all this lines to keep them at a constant temperature. No vaporization is allowed. Unloading lines during no ship unloading and between LNG ship arrivals, the cooling operation is performed by the recirculation of LNG from the LP send out header through one of the unloading lines up to the unloading arms isolation valves. The recirculation flow is returned back to the Terminal through the other unloading line and this LNG is sent to the recondenser during normal operation. Part of the recirculation flow returns to the two storage tanks to keep all tank fill lines cold. In case of the Terminal is in zero send outmode, the LNG from recirculation lines is sent to the tanks and the BOG generated is sent to the flare. LP LNG pumps discharge lines: the discharge line of each LP pump that is not in service is kept cold by circulating LNG from the LP send out header up to pump well through a small by-pass around block valves and check valves. The cool down return lines, which are located as close as possible to vaporizers inlet flange, send the LNG from each vaporizer to the tanks via the recirculation lines. Trucks loading lines: using LNG from the LP pumps the truck loading lines are kept cold. The LNG is sent back to the tanks.

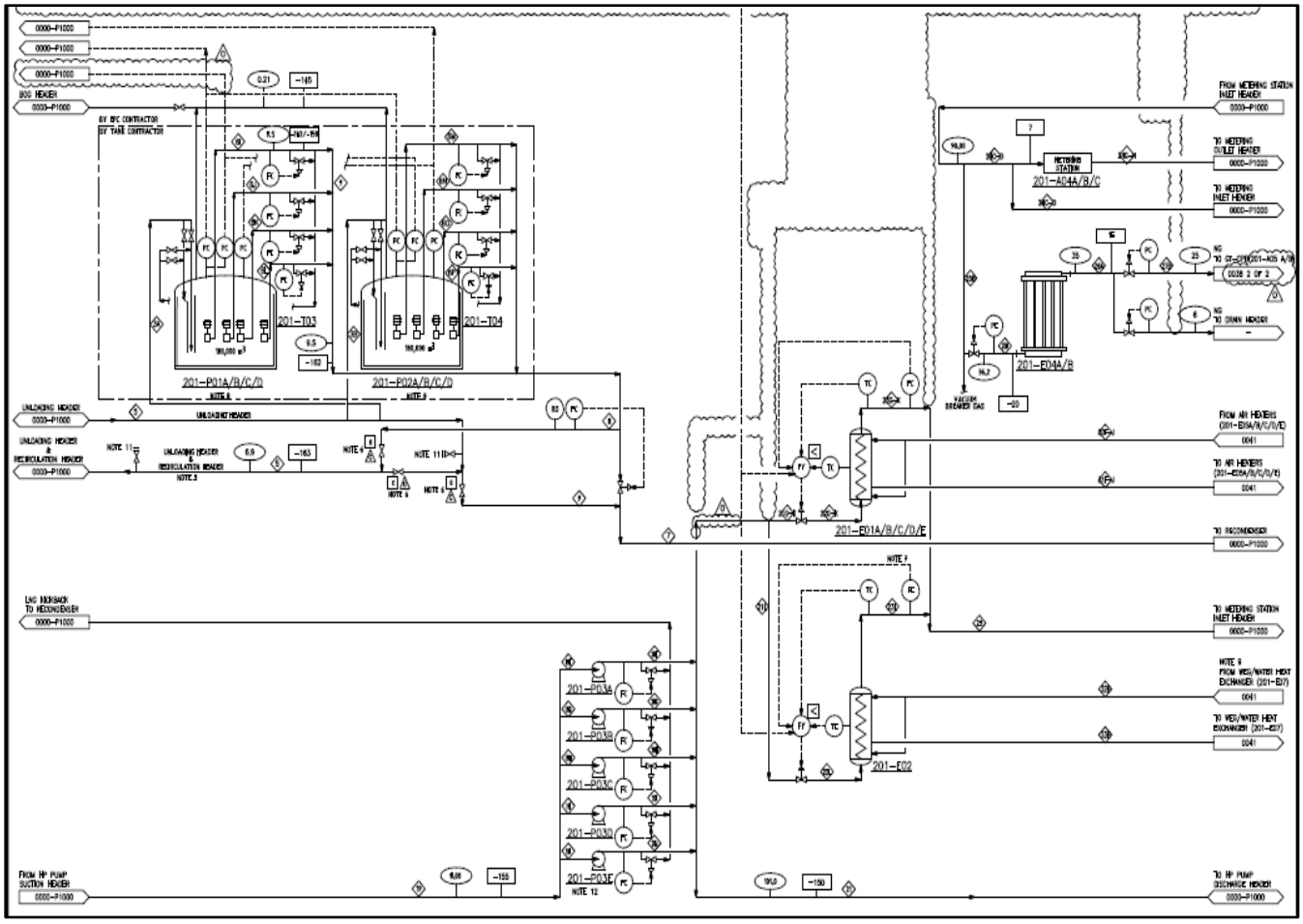


Figure 2.1: PFD of the proposed process facilities

2.3 Utilities and Ancillary Facilities

Nitrogen

Nitrogen is required at the terminal for equipment purging and maintenance purposes. Adequate on site nitrogen generation and storage for liquid nitrogen will be provided at the terminal. The nitrogen generation is based on normal purging and maintenance requirements. For start-up and/or LNG tank purging, additional nitrogen will be made available on site by providing liquid nitrogen tanks from supply vehicles.

Air

Instrument and utility air for use within the terminal are produced on site. Three air compressors will provide necessary air for instrument, plant air and Nitrogen. Regenerative instrument air drying system, separate instrument and utility receivers, and piping headers are provided.

Power

Total power requirement for the proposed project is 12 MW. The additional power requirement will be met from own Captive Power Plant. A battery supplied UPS (Uninterrupted Power Supply) system powers the Emergency Shutdown (ESD) and gas and

fire systems to ensure the operation of critical systems in the unlikely event of a complete failure of the power.

Raw Water system

For proposed project treated water requirement is 10 m3/hr. The water will be used mainly for service water, fire water make up, horticulture and drinking water. Water will be generated in-house from atmosphere.

Waste and Wastewater Treatment

In LNG vaporization scheme normally no liquid, gaseous and solid waste is generated. Only domestic sewage is generated, which is collected and handled through soak-pit/ septic tanks.

Gas Detection, Alarm, Firefighting and ESD Systems

A centralized spill, fire and combustible gas alarm and control system will provide input to an information management system. Automatic detection devices, manual alarms and audible and visual signaling devices will be strategically located throughout the terminal. Automatic detection devices will include flame, fire and heat, smoke, low temperature and combustible gas detectors. CCTV monitors will be installed to allow visual surveillance of critical facilities from the central control room. An emergency shutdown system (ESD) will be incorporated in the design of the terminal and provide the operators with the capability of remotely shutting down the entire or selective portions of the terminal.

Communications

The terminal will be outfitted with up-to-date communications equipment capable of maintaining contact with the LNG carriers scheduled to offload at the terminal and with the standby tugs.

Buildings

Switchgear/MCC Building - will house switchgear, motor control centers, panel boards, UPS, batteries and battery charges, lighting transformers, PLC panels for switchgears, MCCs, generator control panels and other equipment. Additional buildings based on requirements would be provided.

2.4 Land Requirement

For this proposed project, no additional land is required. All the proposed project facilities are coming up within the existing LNG Terminal complex area. Total area of Ennore LNG terminal is 128 acres. Existing green belt area of terminal is 42.24 acres. The plot plan of proposed plant is attached as Figure 2.2 and **Annexure-IV**.

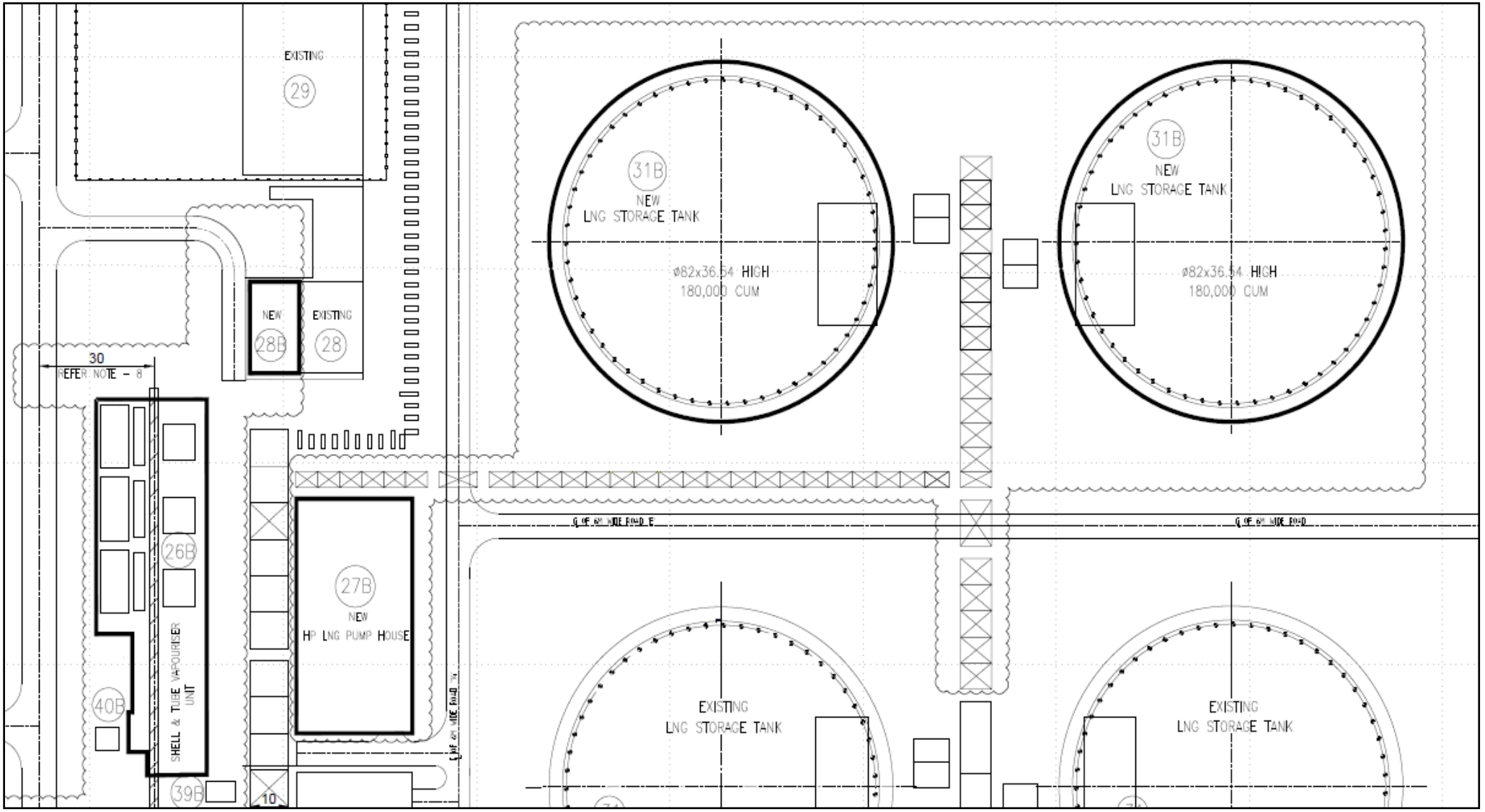


Figure 2.2: The Plot Plan of the Expansion project at Ennore LNG terminal

CHAPTER – 3

DESCRIPTION OF THE ENVIRONMENT

3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

This chapter describes 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. The existing environmental setting is considered to adjudge the baseline environmental conditions, which are described with respect to climate & meteorology, land use, water quality, soil quality, noise levels, vegetation pattern, ecology, traffic density and socio -economic profile of local communities. This would help in assessing the environmental impacts due to the proposed project.

This report incorporates the baseline data monitored during March, 2022 to May, 2022 at Ennore LNG Terminal, Chennai site. M/s J.P. Test & Research Center, Ghaziabad, Uttar Pradesh (Accredited by NABL) has carried out baseline data collection for Meteorology, air, water, noise, traffic and soil environment during the above mentioned time period.

3.2 AIR ENVIRONMENT

3.2.1 Meteorology Condition

Meteorological conditions at the site regulate the transport and diffusion of air-pollutants released into the atmosphere. Ambient temperature, wind speed, wind direction and atmospheric stability are called primary or basic meteorological parameters because the dispersion and diffusion of pollutants depend mainly on these parameters. Humidity, precipitation, pressure and visibility are secondary meteorological parameters as this control the dispersion of the pollutants indirectly by affecting primary parameters.

3.2.1.1 Site Specific Meteorological Data

A meteorological station was installed on the rooftop of the project site at Ennore LNG Terminal, Chennai. Wind speed, Wind direction, Temperature, Relative Humidity and general weather conditions were recorded on hourly basis throughout the study period.

Temperature

The maximum and minimum dry bulb temperatures recorded during the study period were 42.5° C and 22.5° C respectively, while the average temperature was 31.5°C.

Relative Humidity

During the study period, mean humidity was recorded at 70.8% while maximum and minimum humidity were observed as 52% and 86% respectively.

Wind Pattern

During the study period, the average wind velocity was observed as 2.2 m/s ranging from calm condition to 18.8 m/s. The corresponding wind rose diagram is shown in **Fig.3.1.**

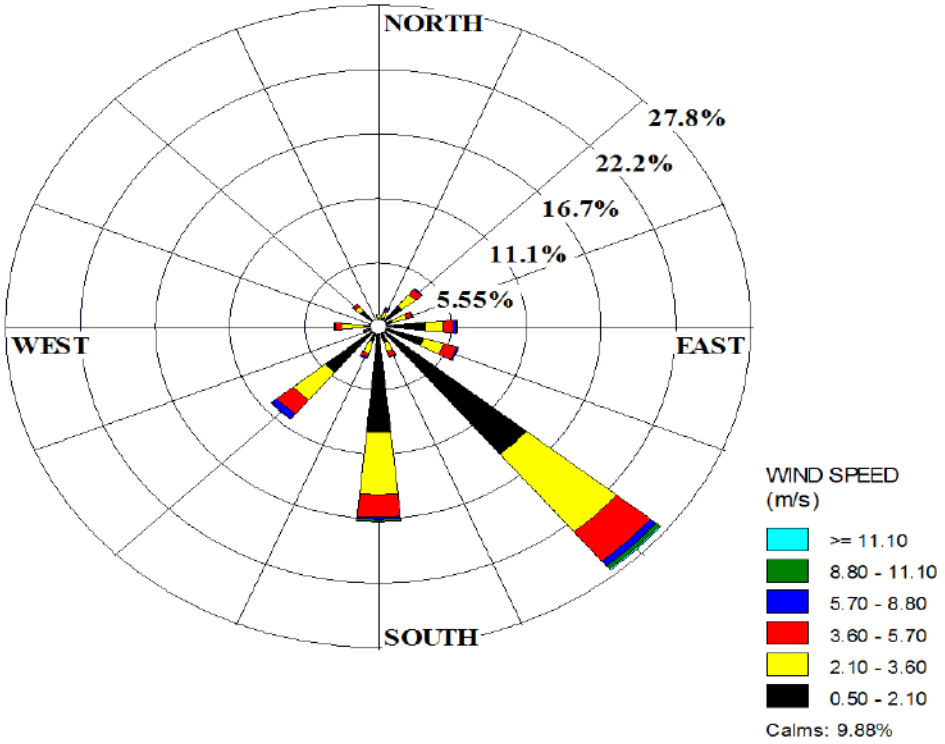


Figure:3.1 Onsite Wind-rose Diagram for Innore LNG Terminal

Table 3.1: Micro-meteorology of the Project Site

Temperature (ºC)			Humidity (%)		
Max	**Min**	**Avg.**	**Max**	**Min**	**Avg.**
42.5	22.5	31.5	86	52	71
Wind Speed (m/s)			**Pre-dominant Wind Direction**		**Rainfall (mm)**
Max	**Min**	**Avg.**			
18.8	Calm	2.2	South East to North West		17.3

Figure 3.2: Meteorological Station Installed at Project Site

3.2.1.2 Metrological Condition

Micro-meteorological Data

To record the prevailing meteorological conditions at the site, a meteorological observatory was set up at a height 10m above the ground level at the project site. Both primary and secondary data were collected for this project and compared to understand the micrometeorological conditions prevailing in the project area. This is described in the subsequent sections

Secondary Data (IMD, Chennai Nandiambakkam)

Secondary data collected from IMD, Chennai (Nandiambakkam) station provided the following details. The monthly mean maximum temperature was recorded 32.9^{0}C and the monthly mean minimum temperature was recorded 24.6^{o}C. Maximum temperature was recorded in the month of May, whereas minimum in the month of January.

The monthly maximum and minimum humidity levels were recorded 83% and 62 % respectively. Maximum humidity levels were recorded in the month of Nov, and October and minimum humidity levels were recorded in the months of May and June. Maximum annual rainfall was 407.4 mm observed in the month of November (Refer **Table - 3.2**).

Table – 3.2: Monthly Mean values of Meteorological Data

Month	Temperature (^{0}C)			Relative Humidity (%)		Rainfall (mm)
	Max.	Min.	Avg.	Min.	Max.	
January	30.7	18.4	24.6	81	67	22.5
February	33.0	19.3	26.2	80	67	2.2
March	35.2	21.2	28.2	78	68	4.0
April	38.0	23.6	30.8	74	71	7.7
May	41.4	24.4	32.9	67	68	43.9
June	40.2	23.7	32.0	63	62	55.9
July	38.2	22.9	30.6	70	65	100.3
August	37.0	22.7	29.9	73	67	140.4
September	36.6	22.8	29.7	77	72	137.3
October	35.0	22.2	28.6	82	76	278.8
November	32.3	20.2	26.3	83	76	407.4
December	30.2	19.1	24.7	81	72	191.1
					Total	**1391.5**

Source: (IMD, Chennai, Nandiampakkam)

Primary Data (Data generated near proposed project site)

An automatic weather station was installed at a height of 10 m at proposed project site. Hourly observations were recorded for temperature, humidity, wind direction, wind speed and rainfall. The data collected are depicted in the form of 'wind rose diagram'.

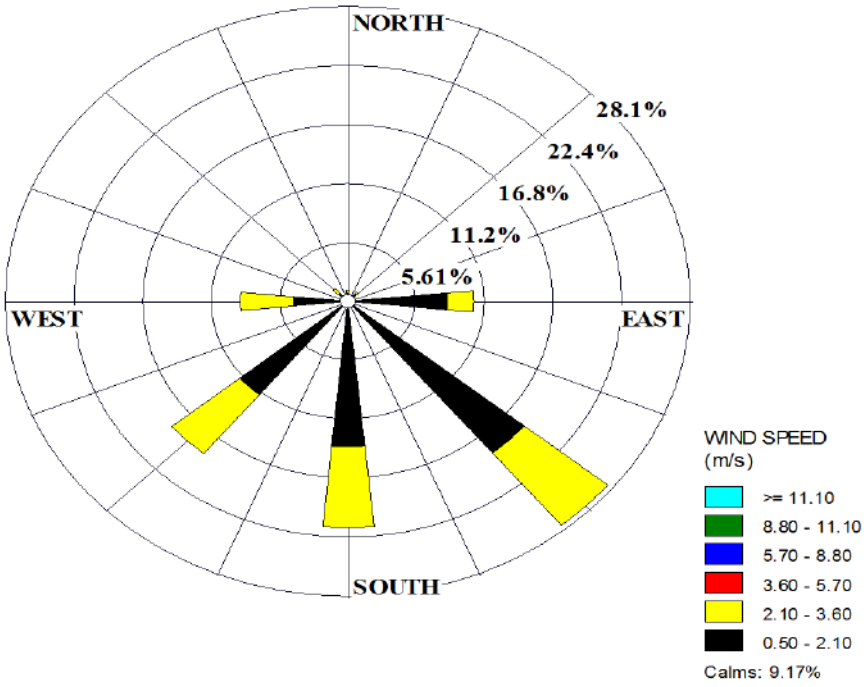


Figure 3.3: Secondary Data - Wind Rose Diagram (March.-May, 2022)

3.2.2 Ambient Air Quality

Monitoring locations have been selected on the basis of predominant Up-wind & Down-wind directions, Topography, habitation and sensitive receptors. All probable directions, which may be polluted due to the emission from the project activity, have been covered.

The monitoring stations have been setup in order to locate the locations as close as feasible to the anticipated maximum pollutant concentration areas. Logistic considerations such as accessibility, security, and availability of reliable power supply etc. were also examined while finalizing the stations. The monitoring locations are depicted in **Table 3.4.**

Table 3.3: Ambient Air Quality Monitoring Stations

Sampling Location	Code	Latitude / Longitude	Direction from project site	Distance from Project Site
Minjur	AAQ-1	13°16'43.06"N 80°15'42.49"E	W	7.8 km
Manali	AAQ-2	13°12'20.17"N 80°16'42.09"E	S	9.5 km
Vallur	AAQ-3	13°13'55.40"N 80°16'29.09"E	SW	8.5 km
Athipattu	AAQ-4	13°15'4.82"N 80°18'18.79"E	S	5.0 km

Sampling Location	Code	Latitude / Longitude	Direction from project site	Distance from Project Site
Vichoor	AAQ-5	13°13'10.30"N 80°16'7.15"E	SW	9.6 km
Nandiampakkam	AAQ-6	13°15'43.55"N 80°17'13.10"E	SW	5.5 km
Voyalur	AAQ-7	13°18'58.76"N 80°16'44.70"E	NW	6.5 km
Ennore Village	AAQ-8	13°13'3.82"N 80°19'10.42"E	S	7.5 km

Note: The distance and direction of the monitoring location has been considered from the mid of the project site.

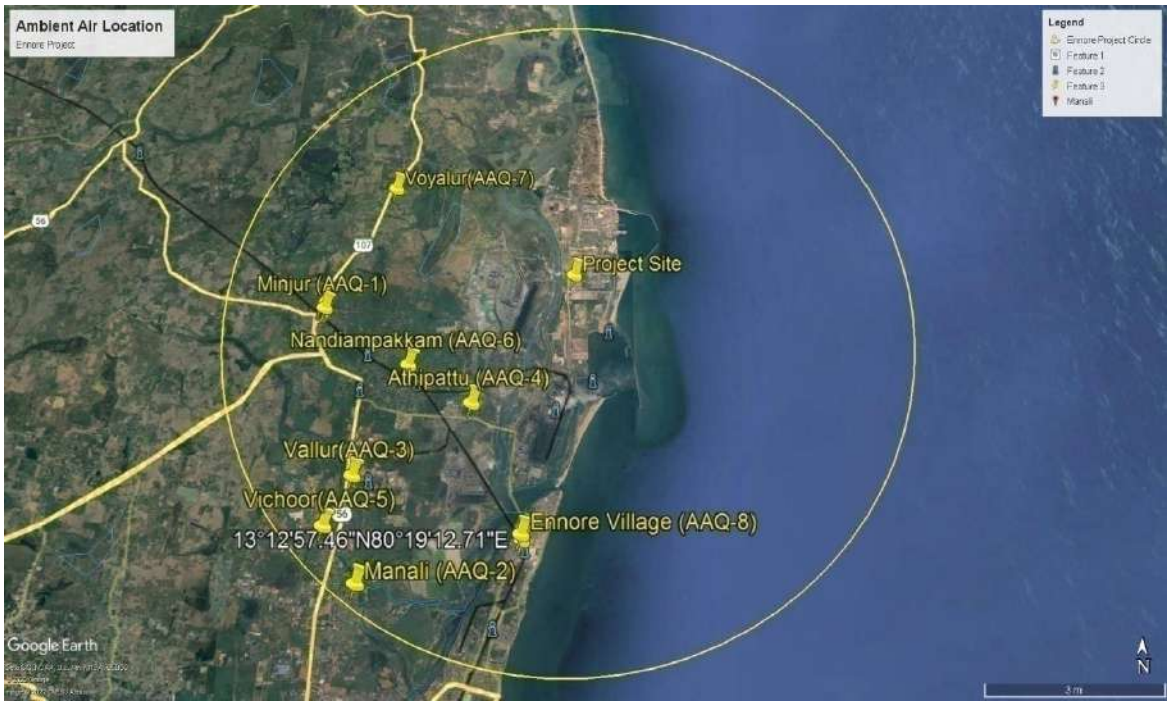


Figure- 3.4: **Air Quality Monitoring Sampling Locations Map – Ennore LNG Terminal**

Parameters, Frequency and Monitoring Methodology

Ambient air quality monitoring has been carried out with a frequency of two samples per week at eight locations in a day for Ennore LNG Terminal. Baseline data of ambient air has been generated for the following parameters as mentioned below.

- PM_{10}
- $PM_{2.5}$
- Sulphur-dioxide (SO_2)
- Oxides of Nitrogen (NO_X)
- Carbon monoxide (CO)
- Benzene
- Hydrocarbon (Methane & Non-Methane)
- VOCs

The equipment was placed at open space free from trees and vegetation which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. Monitoring has been carried out as per the latest CPCB and MoEFCC guidelines and notifications.

Respirable Dust Samplers were installed for monitoring gaseous pollutants like Particulate Matter 10 (PM_{10}), SO_2, NOx, Whereas the concentration Particulate Matter 2.5 ($PM_{2.5}$) were monitored by installing Fine Particulate Sampler. Benzene in ambient air was sampled using Benzene Sampler and analysed using GC. Carbon Monoxide & Hydrocarbon Sample in the ambient air was collected in Tedler Bag.

Duration and Frequency of Sampling

The monitoring has been carried out at a frequency of Twice in a week at each station, adopting a continuous 24-hour schedule except for CO and Benzene.

AAQ Standards

The standards of the air quality are set at a level necessary for an adequate margin of safety, to protect the public health, vegetation and property. The Ambient Air Quality standards have been notified by the Ministry of Environment and Forests (vide Gazette Notification dated 16th Nov 2009). The standards are given in **Table 3.4** below.

Table 3.4: National Ambient Air Quality Standards

Pollutant	Concentration in µg/m^3 except for CO in mg/m^3		
	Time	Industrial, Residential, Rural & other areas	Ecologically Sensitive area (Notified by Central Govt.)
PM_{10} (µg/m^3)	Annual Avg. 24 hours	60 100	60 100
$PM_{2.5}$ (µg/m^3)	Annual Avg. 24 hours	40 60	40 60
Sulphur Dioxide (µg/m^3)	Annual Avg.* 24 hours**	50 80	20 80
Oxides of Nitrogen (µg/m^3)	Annual Avg. 24 hours	40 80	30 80
CO (mg/m^3)	8 hourly 1 hourly	02 04	02 04
Benzene (C_6H_6)	Annual Avg.	5	5

Source: Gazette of India Notification, dated 16th Nov, 2009.

***** *Annual Arithmetic Means of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.*

****** *24 hourly or 8 hourly or 01 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed the limits but not on two consecutive days of monitoring.*

Figure3.5: Site Photographs of AAQ monitoring during Study Period

Table 3.5: Ambient Air Quality – Methodology

Pollutants			Method of analysis
Dust	PM_{10}	Particulate Matter	Gravimetric Method by using Repairable particulate matter sampler Cyclonic flow Technique “Repairable Dust Sampler” (RDS).(IS:5182 (Part-23:2006) RA 2017)
	$PM_{2.5}$	Particulate Matter	Gravimetric method by using Fine particulate sampler. IS:5182 (Part-24:2019)
Gases	NO_2	Nitrous Oxide	Absorption in diluted NaOH and then estimated calorimetrically with sulphanilamide and N (I-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (IS: 5182 (Part-06) 2006 RA 2017).
	SO_2	Sulphur Dioxide	Absorption in Sodium Tetra Chloromercurate followed by Colorimetric estimation using P-Rosaniline hydrochloride and Formaldehyde (IS: 5182 (Part-02) 2001 RA 2017).
	CO	Carbon monoxide	GC method- IS: 5182 (Part-10)1999 RA 2019

Pollutants			Method of analysis
	C_6H_6	Benzene	GC method- IS: 5182 (Part-11) 2006 RA 2017
	HC	Hydrocarbons	GC Method-IS 5182 (Part 17)
	VOC	Volatile Organic Compounds	GC Method – EPA 21 PID

Monitoring Results

The overall Statistical analysis (Minimum, Maximum, Arithmetic Mean, Standard deviation and 98-Percentile values through-out the study period) of the ambient air quality in region are shown in **Table 3.6** to **Table 3.10** and summarized in **Table 3.11**.

Particulate Matter$_{10}$ (PM $_{10}$)

During the monitoring period the 98th percentile value of PM_{10} varies between 58.3 μg/m^3 at Vallur and 78.7 μg/m^3 at Athipattu. However, the values were found to be below the National Ambient Air Quality Standards (NAAQS).

Table 3.6: Particulate Matter 10 (PM_{10}) in μg/m^3

Location Code	Min	Max	STD. DEV.	98th % tile	AVERAGE
AAQ-1	41.6	60.5	5.7	59.2	49.7
AAQ-2	43.9	62.4	5.4	61.6	52.9
AAQ-3	42.2	59.2	4.3	58.3	51.0
AAQ-4	51.3	79.2	7.3	78.7	70.5
AAQ-5	39.4	59.5	5.2	58.6	51.3
AAQ-6	46.3	74.2	8.0	73.5	58.1
AAQ-7	38.7	58.4	5.8	57.8	49.8
AAQ-8	43.9	76.4	7.9	75.8	66.3

Particulate Matter$_{2.5}$ (PM $_{2.5}$)

The 98th percentile value of $PM_{2.5}$ varies between 26.7 μg/m^3 at Vallur and 39.5 μg/m^3 at Athipattu. The concentration of PM2.5 was found to be well below the National Ambient Air Quality Standards (NAAQS).

Table 3.7: Particulate Matter 2.5 ($PM_{2.5}$) in μg/m^3

Location Code	Min	Max	STD. DEV.	98th % tile	AVERAGE
AAQ-1	19.8	28.1	2.5	27.3	24.1
AAQ-2	21.8	30.1	1.8	29.5	26.4
AAQ-3	21.4	27.3	1.3	26.7	24.4
AAQ-4	24.2	40.1	3.1	39.5	33.5
AAQ-5	20.2	29.4	2.1	28.7	24.5
AAQ-6	21.8	33.4	3.0	32.9	27.6
AAQ-7	19.5	28.9	2.2	28.0	24.3
AAQ-8	22.7	38.5	3.1	37.6	22.7

Sulphur Dioxide (SO_2)

During the monitoring period the 98th percentile value of SO_2 varies between 9.8 μg/m^3 at Voyalur and 15.7 μg/m^3 at Athipattu. The concentration of SO_2 was found to be well below the National Ambient Air Quality Standards.

Table 3.8: Sulphur Dioxide (SO_2) in μg/m^3

Location Code	Min	Max	STD. DEV.	98th % tile	AVERAGE
AAQ-1	7.6	11.5	5.7	10.8	8.9
AAQ-2	8.2	15.2	1.6	14.6	10.6
AAQ-3	7.1	11.3	1.0	10.6	8.4
AAQ-4	9.2	16.2	1.5	15.7	12.7
AAQ-5	6.5	10.9	1.2	10.5	8.4
AAQ-6	7.7	11.2	1.0	10.9	8.8
AAQ-7	6.7	10.3	0.8	9.8	8.3
AAQ-8	7.9	15.3	1.4	14.9	12.6

Oxides of Nitrogen (NOx)

During the monitoring period the 98th percentile value of NO_x varies between 17.7 μg/m^3 at Voyalur Village and 26.9 μg/m^3 at Ennore Village. The concentration of NOx was found to be well below the National Ambient Air Quality Standards.

Table 3.9: Oxides of Nitrogen (NO_X) in μg/m^3

Location Code	Min	Max	STD. DEV.	98th % tile	AVERAGE
AAQ-1	14.0	19.7	1.6	18.2	16.0
AAQ-2	16.4	24.1	2.1	23.5	19.8
AAQ-3	13.3	21.9	2.6	21.0	16.9
AAQ-4	15.7	27.4	2.7	26.6	22.4
AAQ-5	12.3	19.3	1.9	18.6	14.9
AAQ-6	13.2	22.7	2.4	21.9	17.3
AAQ-7	12.9	18.4	14.8	17.7	15.7
AAQ-8	13.2	27.0	3.2	26.9	23.7

Carbon Monoxide (CO)

During the monitoring period the 98th percentile value of CO varies between 0.47 mg/m^3 at Voyalur and 1.04 mg/m^3 at Ennore Village. The concentration of CO was found to be well below the National Ambient Air Quality Standards.

Table 3.10: Carbon monoxide (CO) in mg/m^3

Location Code	Min	Max	STD. DEV.	98th % tile	AVERAGE
AAQ-1	0.29	0.49	0.05	0.48	0.43
AAQ-2	0.36	0.80	0.11	0.79	0.60
AAQ-3	0.38	0.54	0.04	0.51	0.44
AAQ-4	0.41	0.97	0.14	0.92	0.66

AAQ-5	0.37	0.56	0.04	0.52	0.43
AAQ-6	0.34	0.68	0.08	0.64	0.49
AAQ-7	0.32	0.49	0.04	0.47	0.39
AAQ-8	0.34	1.06	0.17	1.04	0.34

Volatile Organic Compounds (VOC's):

Total Hydrocarbon

The Hydrocarbon level were observed to be below detection limit (BDL <0.5 mg/m^3).

Benzene

Benzene sample were collected in tedlar bags. The benzene level were observed to be below detection limit (BDL <5 μg/m^3).

Table 3.11: Consolidated Values of AAQ (98th percentile)

98th Percentile Values in μg/m^3 except for CO & Hydrocarbon in mg/m^3							
Code	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NOx**	**CO**	**Benzene**	**HC**
AAQ-1	59.2	27.3	10.8	18.2	0.48	<5	<0.5
AAQ-2	61.6	29.5	14.6	23.5	0.79	<5	<0.5
AAQ-3	58.3	26.7	10.6	21.0	0.51	<5	<0.5
AAQ-4	78.7	39.5	15.7	26.6	0.92	<5	<0.5
AAQ-5	58.6	28.7	10.5	18.6	0.52	<5	<0.5
AAQ-6	73.5	32.9	10.9	21.9	0.64	<5	<0.5
AAQ-7	57.8	28.0	9.8	17.7	0.47	<5	<0.5
AAQ-8	75.8	37.6	14.9	26.9	1.04	<5	<0.5

Note: 24 hourly or 8 hourly or 01 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed the limits but not on two consecutive days of monitoring.

3.3 NOISE ENVIRONMENT

Major Sources of Noise in the Study Area

The vehicular movement on nearby roads is one of the major sources of noise, which significantly increases ambient noise levels.

Ambient Noise Monitoring- Methodology and Monitoring Stations

In the present study, sound pressure levels (SPL) have been measured by a sound Level Meter (Model: Lutron SL-4033). Since loudness of sound is important for its effects on people, the dependence of loudness upon frequency must be taken into account in environmental noise assessment.

A total of Eight (8) locations in the study area have been selected for measurement of ambient noise levels for Ennore LNG Terminal project.

These locations are presented in **Table 3.12**. Ambient Noise standards (CPCB) are presented in **Table 3.13**.

Table 3.12: Ambient Noise Monitoring Stations

Sampling Location	Code	Latitude / Longitude	Direction from project site	Distance from Project Site
Minjur	N-1	13°16'43.06"N 80°15'42.49"E	W	7.8 km
Manali	N-2	13°12'20.17"N 80°16'42.09"E	S	9.5 km
Vallur	N-3	13°13'55.40"N 80°16'29.09"E	SW	8.5 km
Athipattu	N-4	13°15'4.82"N 80°18'18.79"E	S	5.0 km
Vichoor	N-5	13°13'10.30"N 80°16'7.15"E	SW	9.6 km
Nandiampakkam	N-6	13°15'43.55"N 80°17'13.10"E	SW	5.5 km
Voyalur	N-7	13°18'58.76"N 80°16'44.70"E	NW	6.5 km
Ennore Village	N-8	13°13'3.82"N 80°19'10.42"E	S	7.5 km

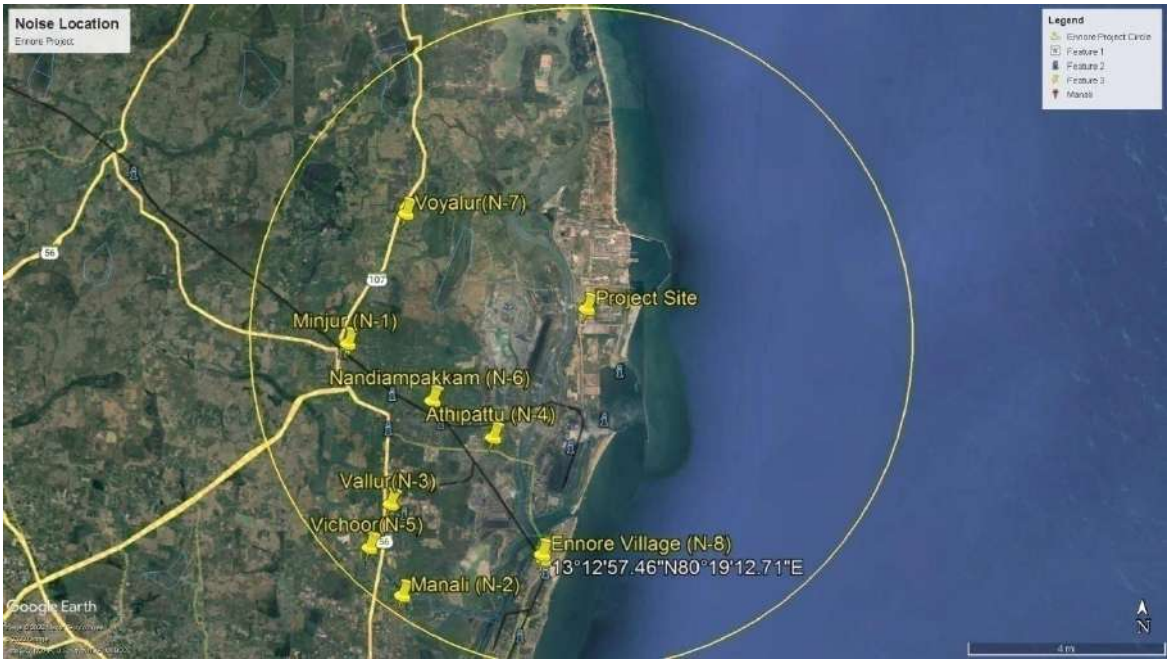


Figure 3.6: Map showing Noise monitoring locations in study area of 10 km radius

At each location, noise monitoring has been carried out twice in a month manner for the entire study period. To obtain the Leq values a uniform time intervals of 1 hour have maintained. For each location, day and night time Leq values have then been computed from the hourly Leq values such that comparison could be made with the national ambient noise standards. Day time Leq has been computed from the hourly Leq values

between 6.00 a.m. - 10.00 p.m. and night time Leq from the hourly Leq values between 10.00 p.m. - 6.00 a.m.

Table 3.13: Ambient Noise Standards

Type of Area	Limits in dB (A) Leq*	
	Day Time	Night Time
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

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

Source: Pollution Control Acts, Rule and Notifications issued there under, by Pollution Control Law Series: PCLS/02/2006 (Fifth Edition) of Central Pollution Control Board, January 2006, pp 926 Day and Night time shall mean from 6:00 a.m. to 10:00 p.m. and 10:00 p.m. to 6:00 a.m. respectively.


Figure3.7: Site Photographs of Noise level monitoring during Study Period

Ambient Noise Level in the Study Area

The hourly recorded noise level at various locations in the study area shows fluctuations because of change in traffic movement and other man made sources. The equivalent values of noise levels are 49.4 dB to 58.6 dB (A) during daytime and 36.1 dB to 41.0 dB (A) during night time in the month of March, 2022 which are within the prescribed norms of CPCB.

Table 3.14: Ambient Noise Level in the Study Area march 2022

Location	Noise Location	Day			Night		
		L Max	L Min	L eq	L Max	L Min	L eq
ENNORE LNG TERMINAL	Minjur	53.6	41.7	49.8	37.9	33.9	36.1
	Manli	55.6	43.1	51.4	40.2	33.1	37.4
	Vallur	54.5	41.4	50.2	39.2	33.9	36.9

Location	Noise Location	Day			Night		
		L Max	L Min	L eq	L Max	L Min	L eq
	Athipattu	65.5	45.2	58.6	43.2	36.2	41.0
	Vichoor	53.1	41.5	49.4	38.2	35.8	36.8
	Nandiampakkam	57.8	42.2	53.7	43.2	34.8	39.4
	Vayalur	56.8	43.1	53.0	41.3	34.5	37.8
	Ennore	57.3	43.2	52.8	40.4	35.6	39.0

3.3.1 TRAFFIC

To study the traffic levels four monitoring stations were selected. The average traffic levels over the study period at all the four stations are calculated in terms of PCU and are given in **Table - 3.15**.

Value of PCU:

Table 3.15: Average traffic data (PCU)

Car	1.0
Motorcycle	0.5
Bicycle	0.2
LCV	2.2
Bus, Truck	3.5
3 wheeler	0.8

The detailed traffic data from March 2022 are given in **Table 3.16.**

Table 3.16: Study Period: March to June 2022

Location	Code	Locations	HMV	LMV	2-Wheeler	Total
ENNORE LNG TERMINAL	T1	Minjur	416	314	418	1148
	T2	Manali	295	262	318	875
	T3	Vallur	152	216	252	620
	T4	Athipattu	274	195	418	887
	T5	Vichoor	190	432	302	924
	T6	Nandiampakkam	480	288	492	1260
	T7	Voyalur	228	456	420	1104
	T8	Ennore Village	318	510	505	1333

3.4 WATER ENVIRONMENT

Sampling Locations

To assess the present water quality within the Impact Zone (10 km radius from the project site), Six ground and Six surface Water Sampling locations (each) have been selected. The water quality sampling locations are given in **Table 3.17**.

Table 3.17: Water Sampling Locations

Location	Sampling Code	Water Sampling Location	Source	Direction	Distance
ENNORE LNG TERMINAL	**Ground Water Sampling Location**				
	GW1	Ennore	Handpump	S	8.2 km
	GW2	Voyalur	Borewell	NW	4.5 km
	GW3	Vallur	Borewell	SW	7.5 km
	GW4	Manali	Borewell	S	9.3 km
	GW5	Athipattu	Borewell	S	4.5 km
	GW6	Minjur	Borewell	W	5.7 km
	Surface Water Sampling Location				
	SW1	Ennore	River	S	7.2 km
	SW2	Manali	Pond	S	11.2 Km
	SW3	Kosasthalaiyar River Near Project Site	River	-	1 km
	SW4	Sea Water Near Ennore Plant	Sea Water	SE	1.5 km
	SW5	Voyalur	Pond	NW	6.5 km
	SW6	Minjur	Pond	W	8.2 Km

Table 3.18 : Methods of Analysis of Water Samples

S. No.	Parameters	Detection limit	Instrument Method	Instruments Used	IS Method
1	pH value at 25^0C	1	pH meter	pH electrode	IS 3025 (part-11)
2	Temperature	1^0C	Tracer	Thermometer	APHA, page 25-26
3	Turbidity	1NTU	Nephelometric method	Turbidity meter	IS 3025 (part-10)
4	Color	1	Visual Comparison	Visual Comparison	Visual
5	Total Suspended Solids	1	Filtration & Evaporation	Balance	IS 3025 (part-17)
6	Total Dissolved Solids	1	Evaporation method	Balance	IS 3025 (part-16)
7	T. Alkalinity as $CaCO_3$	2	Titration Method	Burettes	IS 3025 (part-23)
8	Total Hardness as $CaCO_3$	2	EDTA Titrimetric method	Burettes	IS 3025 (part-21)
9	Sodium as Na	0.1	Flame Photometric Method	Flame Photometer	IS 3025 (part-45)
10	Potassium as K	0.1	Flame Photometric Method	Flame Photometer	IS 3025 (part-45)
11	Chloride as Cl	1	AgNO3 Titrimetric	Burettes	IS 3025 (part-32)

S. No.	Parameters	Detection limit	Instrument Method	Instruments Used	IS Method
			method		
12	Sulphate as SO_4	1	Turbidity Method	Spectrophotometer	IS 3025 (part-24)
13	Nitrate as NO_3	0.1	U.V.Spectrophotometric	Spectrophotometer	IS 3025 (part-34)
14	Total Phosphate (PO4)	0.03	Stannous chloride colorimetric	Spectrophotometer	IS 3025 (part-31)
15	Phosphorous (P)	0.03	Stannous chloride colorimetric	Spectrophotometer	IS 3025 (part-31)
16	Total Nitrogen (as N)	0.05	U.V.Spectrophotometric	Spectrophotometer	IS 3025 (part-34)
17	Fluoride as F	0.1	SPADNS method	Spectrophotometer	IS 3025 (part-60)
18	Calcium Hardness as CaCO3	2	EDTA Titrimetric method	Burettes	IS 3025 (part-21)
19	Magnesium Hardness as CaCO3	1	EDTA Titrimetric method	Burettes	IS 3025 (part-21)
20	Iron	0.05	Atomic Absorption Spectrophotometer method	Atomic Absorption Spectrophotometer	APHA 3111 B
21	Cadmium	0.01			
22	Total Chromium as Cr	0.05			
23	Copper	0.05			
24	Lead	0.05			
25	Manganese	0.02			
26	Zinc	0.01			
27	Nickel	0.05			
28	Dissolved Oxygen	0.1	Winkler's method	Burettes	IS 3025 (part-38)
29	Chemical Oxygen Demand	4	Open reflux method	COD digester	IS 3025 (part-58)
30	Biochemical Oxygen Demand	1	Dilution & DO by Winkler's	BOD Bottles	IS 3025 (part-44)
31	Total Coliforms	-	Filtration	Filtration Assembly	IS 15185
32	Feacal Coliform	2	MPN Method	Incubators	IS 1622

Figure-3.8: Ground Water Sampling Locations Map – LNG Terminal Ennore

Figure-3.9: Surface Water Sampling Locations Map – LNG Terminal Ennore

Sampling and Analysis Methodology & Sampling Period

The water samples have been collected during the month of March 2022. All the basic precautions were taken care to avoid any contamination during the sampling.

Analysis of the samples was carried out as per established standard methods and procedures prescribed by relevant IS Codes and APHA 23rd edition.

Figure-3.10: Ground Water Sampling Site Photographs During Study Period

Ground 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.

Table 3.19: Ground Water Quality – Ennore LNG Terminal

S. No.	Parameters	Unit	Ennore	Voyalur	Vallur	IS 10500:2012 Amnd 4	
						Acceptable Limits	Permissible Limits
1	pH value at 25^0C	--	8.02	7.32	6.95	6.5-8.5	No Relaxation
2	Temperature	^{0}C	26.1	25.7	24.9	Not Specified	Not Specified
3	Turbidity	NTU	<1	<1	<1	1	5
4	Color	Hazen	< 5	< 5	< 5	5	15
5	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
7	Total Suspended Solids	mg/l	<1	<1	<1	Not Specified	Not Specified
8	Conductivity	µS/cm	2018	2596	2432	Not Specified	Not Specified
9	Total Dissolved Solids	mg/l	1225	1540	1450	500	2000
10	T. Alkalinity as $CaCO_3$	mg/l	304	442	314	200	600
11	Total Hardness as $CaCO_3$	mg/l	458	548	582	200	600
12	Calcium as Ca	mg/l	104	132	143	75	200
13	Magnesium as Mg	mg/l	48.2	53.1	54.7	30	100
14	Sodium as Na	mg/l	268	388	344	Not Specified	Not Specified
15	Potassium as K	mg/l	26	37	29	Not Specified	Not Specified
16	Chloride as Cl	mg/l	462	584	586	250	1000
17	Sulphate as SO_4	mg/l	108	162	212	200	400
18	Nitrate as NO_3	mg/l	13	11	14	45	No Relaxation
19	Total Phosphate (PO4)	mg/l	0.18	<0.03	<0.03	Not Specified	Not Specified
20	Phosphorous (P)	mg/l	0.06	<0.03	<0.03	Not Specified	Not Specified
21	Total Nitrogen (as N)	mg/l	2.9	2.5	3.2	Not Specified	Not Specified
22	Fluoride as F	mg/l	0.5	0.6	0.7	1	1.5
23	Calcium Hardness as CaCO3	mg/l	260	330	357.5	Not Specified	Not Specified
24	Magnesium Hardness as CaCO3	mg/l	198	218	224.5	Not Specified	Not Specified
25	Iron	mg/l	0.23	0.13	0.18	1.0	No Relaxation

S. No.	Parameters	Unit	Ennore	Voyalur	Vallur	IS 10500:2012 Amnd 4	
						Acceptable Limits	Permissible Limits
26	Cadmium	mg/l	<0.003	<0.003	<0.003	0.003	No Relaxation
27	Total Chromium as Cr	mg/l	<0.05	<0.05	<0.05	0.05	No Relaxation
28	Copper	mg/l	<0.01	0.03	<0.01	0.05	1.5
29	Lead	mg/l	<0.01	<0.01	<0.01	0.01	No Relaxation
30	Manganese	mg/l	0.12	0.09	0.11	0.1	0.3
31	Zinc	mg/l	0.06	0.13	0.13	5	15
32	Nickel	mg/l	<0.01	<0.01	<0.01	0.02	No Relaxation
33	Disslolved Oxygen	mg/l	6.7	7.1	7.1	Not Specified	Not Specified
34	Chemical Oxygen Demand	mg/l	< 4	< 4	< 4	Not Specified	Not Specified
35	Biochemical Oxygen Demand	mg/l	<2	<2	<2	Not Specified	Not Specified
36	Total Coliforms	Per 100ml	Absent	Absent	Absent	Should Not Detectable in 100 ml	
37	Feacal Coliform	MPN/100 ml	ND (< 2)	ND(< 2)	ND(< 2)	Should Not Detectable in 100 ml	

S. No.	Parameters	Unit	Manali	Athipattu	Minjur	IS 10500:2012 Amnd4	
						Acceptable Limits	Permissible Limits
1	pH value at 25^0C	--	7.07	6.72	6.68	6.5-8.5	No Relaxation
2	Temperature	^{0}C	26.1	25.9	26.8	Not Specified	Not Specified
3	Turbidity	NTU	3	<1	<1	1	5
4	Color	Hazen	< 5	< 5	< 5	5	15
5	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
7	Total Suspended Solids	mg/l	4	<1	<1	Not Specified	Not Specified
8	Conductivity	µS/cm	5862	2612	3406	Not Specified	Not Specified
9	Total Dissolved Solids	mg/l	3560	1574	2016	500	2000
10	T. Alkalinity as $CaCO_3$	mg/l	462	396	580	200	600

S. No.	Parameters	Unit	Manali	Athipattu	Minjur	IS 10500:2012 Amnd4	
						Acceptable Limits	Permissible Limits
11	Total Hardness as $CaCO_3$	mg/l	846	526	672	200	600
12	Calcium as Ca	mg/l	216	128	162	75	200
13	Magnesium as Mg	mg/l	74.6	50.2	65.1	30	100
14	Sodium as Na	mg/l	942	412	508	Not Specified	Not Specified
15	Potassium as K	mg/l	74	32	45	Not Specified	Not Specified
16	Chloride as Cl	mg/l	1605	612	765	250	1000
17	Sulphate as SO_4	mg/l	246	186	158	200	400
18	Nitrate as NO_3	mg/l	21	16	18	45	No Relaxation
19	Total Phosphate (PO4)	mg/l	0.18	<0.03	0.12	Not Specified	Not Specified
20	Phosphorous (P)	mg/l	0.06	<0.03	0.04	Not Specified	Not Specified
21	Total Nitrogen (as N)	mg/l	4.7	3.6	4.1	Not Specified	Not Specified
22	Fluoride as F	mg/l	0.8	0.6	0.6	1	1.5
23	Calcium Hardness as CaCO3	mg/l	540	320	405	Not Specified	Not Specified
24	Magnesium Hardness as CaCO3	mg/l	306	206	267	Not Specified	Not Specified
25	Iron	mg/l	0.39	0.16	0.22	1.0	No Relaxation
26	Cadmium	mg/l	<0.003	<0.003	<0.003	0.003	No Relaxation
27	Total Chromium as Cr	mg/l	<0.05	<0.05	<0.05	0.05	No Relaxation
28	Copper	mg/l	0.04	<0.01	<0.01	0.05	1.5
29	Lead	mg/l	<0.01	<0.01	<0.01	0.01	No Relaxation
30	Manganese	mg/l	0.03	0.07	0.09	0.1	0.3
31	Zinc	mg/l	0.09	0.08	0.11	5	15
32	Nickel	mg/l	<0.01	<0.01	<0.01	0.02	No Relaxation
33	Disslolved Oxygen	mg/l	6.9	6.8	7.2	Not Specified	Not Specified
34	Chemical Oxygen Demand	mg/l	< 4	< 4	< 4	Not Specified	Not Specified
35	Biochemical Oxygen Demand	mg/l	<2	<2	<2	Not Specified	Not Specified

S. No.	Parameters	Unit	Manali	Athipattu	Minjur	IS 10500:2012 Amnd4	
						Acceptable Limits	Permissible Limits
36	Total Coliforms	Per 100ml	Absent	Absent	Absent	Should Not Detectable in 100 ml	
37	Feacal Coliform	MPN/100 ml	ND(< 2)	ND(< 2)	ND(< 2)	Should Not Detectable in 100 ml	

The pH of the ground water samples varying from 6.68 to 8.02, which is well within the IS 10500 limits 6.5 to 8.5.

Total dissolve solids (TDS) were found in the range of 1225 mg/l to 3560 mg/l. TDS of water samples collected at Minjur and Manali were found to be exceeding IS 10500 desirable limit 500 mg/l& permissible value of 2000mg/l.

Hardness concentration was ranging from 458 to 846 mg/l, Hardness of water samples collected at Minjur and Manali were found to be exceeding the IS 10500 permissible limit 600 mg/l.

Chloride concentration were found in the range of 462 to 1605 mg/l. Chloride of water samples collected at Manali were found to be exceeding the IS 10500 desirable limit 250 mg/l& permission limit 1000 mg/l.

Sulphates concentration was found to be range of 108 to 246 mg/l. which is indicating that in all the ground water samples Sulphate concentration is not exceeding the IS 10500 desirable limit 200 mg/l.

From the above tables, Parameters as pH, Heavy Metals and MPN Coliform were found well within permissible limits as per Indian standards 10500:2012.

Surface Water Quality

Table 3.20: Water Quality Criteria as per CPCB

Designated-Best-Use	Class of Water	pH	Total Coliforms, MPN/100 ml	Dissolved Oxygen, mg/l	Biochemical Oxygen Demand, mg/l	Free Ammonia (as N) mg/l	EC µmhos/cm	SAR	Boron mg/l
Drinking WaterSource without conventional treatment but after disinfection	A	6.5 and 8.5	50 or Less	6mg/l or more	2mg/l or less	-	-	-	-
Outdoor bathing (Organised)	B	6.5 and 8.5	500 or less	5mg/l or more	3mg/l or less	-	-	-	-

Designated-Best-Use	Class of Water	pH	Total Coliforms, MPN/100 ml	Dissolved Oxygen, mg/l	Biochemical Oxygen Demand, mg/l	Free Ammonia (as N) mg/l	EC µmhos/cm	SAR	Boron mg/l
Drinking water source after conventional treatment and disinfection	C	6 to 9	5000 or less	4mg/l or more	3mg/l or less	-	-	-	-
Propagation of Wild life and Fisheries	D	6.5 to 8.5	-	-	4mg/l or more	1.2 mg/l or less	-	-	-
Irrigation, Industrial Cooling, Controlled Waste disposal	E	6.0 to 8.5	-	-	-	-	Max.2250	Max. 26	Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria							

Figure-3.11: Surface Water Sampling Site Photographs during Study Period

Table 3.21: Surface Water Quality at Ennore LNG Terminal

S. No.	Parameters	Unit	Minjur	Manali	Voyalur	Ennore	Korttalai River Near Project Site	Sea Water
1	pH	--	6.62	7.43	6.95	6.79	7.26	7.05
2	Temperature	^{0}C	26.4	25.3	24.3	25.1	23.9	25.2
3	Turbidity	NTU	5	14	6	6	4	7
4	Color	Hazen	< 5	< 5	< 5	< 5	< 5	< 5
5	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Salty
7	Total Suspended Solids	mg/l	21	32	27	17	14	10
8	Total Dissolved Solids	mg/l	567	598	1097	1208	524	222542
9	T. Alkalinity as $CaCO_3$	mg/l	168	132	212	206	109	192
10	Total Hardness as $CaCO_3$	mg/l	232	184	488	462	152	426
11	Calcium as Ca	mg/l	52	48	114	106	36	99
12	Magnesium as Mg	mg/l	24.8	15.6	49.5	48.0	15.1	43.5
13	Sodium as Na	mg/l	99	129	172	220	118	81520
14	Potassium as K	mg/l	17	18	24	24	14	316
15	Chloride as Cl	mg/l	176	212	412	462	196	126150
16	Sulphate as SO_4	mg/l	44	48	84	102	36	186
17	Nitrate as NO_3	mg/l	12	10	16	14	9	7
18	Total Phosphate (PO4)	mg/l	0.64	0.86	0.95	0.34	0.28	0.25
19	Phosphorous (P)	mg/l	0.21	0.28	0.31	0.11	0.09	0.08
20	Total Nitrogen (as N)	mg/l	3.2	3.6	2.9	3.9	2.0	1.6

S. No.	Parameters	Unit	Minjur	Manali	Voyalur	Ennore	Korttalai River Near Project Site	Sea Water
21	Fluoride as F	mg/l	0.5	0.4	0.5	0.6	0.4	0.5
22	Calcium Hardness as CaCO3	mg/l	130	120	285	265	90	247.5
23	Magnesium Hardness as CaCO3	mg/l	102	64	203	197	62	178.5
24	Iron	mg/l	0.41	0.48	0.39	0.31	0.24	0.28
25	Cadmium	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
26	Total Chromium as Cr	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	Copper	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Lead	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Manganese	mg/l	0.05	0.08	0.05	0.07	0.06	0.07
30	Zinc	mg/l	0.06	0.07	0.06	0.05	0.05	0.09
31	Nickel	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Disslolved Oxygen	mg/l	7.0	6.9	6.4	6.7	7.2	6.6
33	Chemical Oxygen Demand	mg/l	24	28	56	32	20	48
34	Biochemical Oxygen Demand	mg/l	3.4	4.7	9.4	5.1	3.2	8.2
35	Total Coliforms	MPN/100ml	5.8×10^3	4.3×10^3	6.3×10^3	3.2×10^3	3.7×10^2	2.53×10^2
36	Faecal Coliform	MPN/100ml	2.2×10^2	2.1×10^2	2.6×10^2	1.4×10^2	79	58

The pH of the surface water samples collected in March, 2022 is found well the tolerance limit as per Class C with pH ranges of 6.62 to 7.43. The BOD value ranges from 3.2 mg/l to 9.4 mg/l. The Dissolved Oxygen value ranges between 6.4 mg/l to 7.2 mg/l. The Coliforms value ranges between 3.2 x 10^3 to 6.3 x 10^3 MPN/100 ml.

3.5 SOIL ENVIRONMENT

Assessment of soil quality is an important aspect with reference to tree plantations, percolation of water, groundwater impact, etc. The soil quality of the study area has been assessed by collecting Eight samples at different locations have been collected for Ennore LNG Terminal.

Field Study and Sampling Locations

For studying soil quality, sampling location was selected to assess the existing soil conditions in and around the project area representing various land use conditions. The sample was collected by ramming a core-cutter into the soil up to 30-cm depth.Two locations is being selected for soil sampling on the basis of soil types, vegetative cover, residential

activities including infrastructure facilities, which would accord an overall idea of the soil characteristics. Soil samples were collected from three different depths viz. 30 cm. The samples were analyzed for physical and chemical characteristics. The sealed samples were sent to laboratory for analysis. Details of soil sampling locations are presented in **Table 3.22**.

Figure-3.12: Soil Sampling Locations Map – LNG Terminal Ennore

Table 3.22: Soil Sampling Locations

Site	S. No.	Location	Code	Direction
Ennore LNG Terminal	1	Minjur	S-1	W
	2	Manali	S-2	S
	3	Vallur	S-3	SW
	4	Athipattu	S-4	S
	5	Near Project Site	S-5	SW
	6	Nandiampakkam	S-6	SW
	7	Voyalur	S-7	NW
	8	Ennore Village	S-8	S

Sampling Frequency and Analysis Methodology

The samples of Soil were collected in the month of March to May, 2022 in the study period. The physical and chemical characteristics of the soil of the study area have been assessed by analyzing various parameters as per the methods described in “Soil Chemical Analysis” (M.L.Jackson) and Department of Agriculture and Cooperation. Standard classification of Soil as per As per ISO: Soil Compendium in **Table 3.23.** Total samples are collected from study area to understand the Physico-chemical and biological status of the existing soil in the region. This will establish the baseline characteristics of the region and shall facilitate in identifying the contamination (if any) due to the proposed project.

Selection of site

- A visual survey of the field is made in slope, texture, and cropping pattern.
- The collection site is demarcated into uniform portions, each of which sampled separately.
- Details of vegetation cover and of chemical and biological additions or accidental contamination are recorded.
- Sampling is made during normal environmental conditions.

Collection

- Surface layer is scrapped to avoid surface vegetation, litter, visible roots and soil fauna.
- The samples are designated according to the sampling area, unit and horizons.
- A sample hole at a depth of 15cm is dug to collect 2kg of soil for physico-chemical analyses.

Transportation conditions

- Soil is packed in a dark polythene bags for transportation to avoid changes in water content.

Sample processing

- Samples are dried in hot air cabinet (at 80^0C).
- After drying, soils are sieved through 2mm size sieve to remove pebbles, gravels, stones and plant debris.
- Then the soil is crushed to fine particles for further analyses.

Storage of samples

- If further storage is required, then the samples are kept at dark at 40C ± 20C with free access of air or in a loosely tied plastic bag.

Table 3.23 Soil Concentration and Assessment of Soil Fertility

Parameter	Units	Concentration	Level
Electrical conductivity	**(uS/cm)**	Up to 1.00	Average
		1.00-2.00	Harmful to germination
		2.01-3.00	Harmful to Crops
Salinity Electrical conductivity	**(mmhos/cm) (1mmho/cm = 640 ppm)**	Upto 1.00	Average
		1.00 – 2.00	Harmful to germination
		2.01 – 3.00	Harmful to Crops (Sensitive to salts)
pH	**--**	<4.5	Very low
		4.5 – 6.0	Low (Acidic)
		6.0 – 7.0	Moderate (Normal)
		7.0 – 8.3	High (Weakly alkaline)
		>8.3	Very High (Alkaline)
Nitrogen (N)	**(kg/ha)**	<100	Low

Parameter	Units	Concentration	Level
		>100-150	Good
		>150-300	Better
Phosphorus (P_2O_5)	**(kg/ha)**	00-20	Low
		>20-50	Medium
		>50-80	High
Potassium (K_2O)	**(kg/ha)**	00-150	Low
		151-300	Medium
		>300	High
Organic Carbon (%)		<0.4	Low
		0.4-0.5	Medium
		0.51-0.8	Average
		2	Preferred
Ca:Mg ratio	**(meq/100g)**	3	Preferred

Source: As per ISO: Soil Compendium

Soil Characteristics

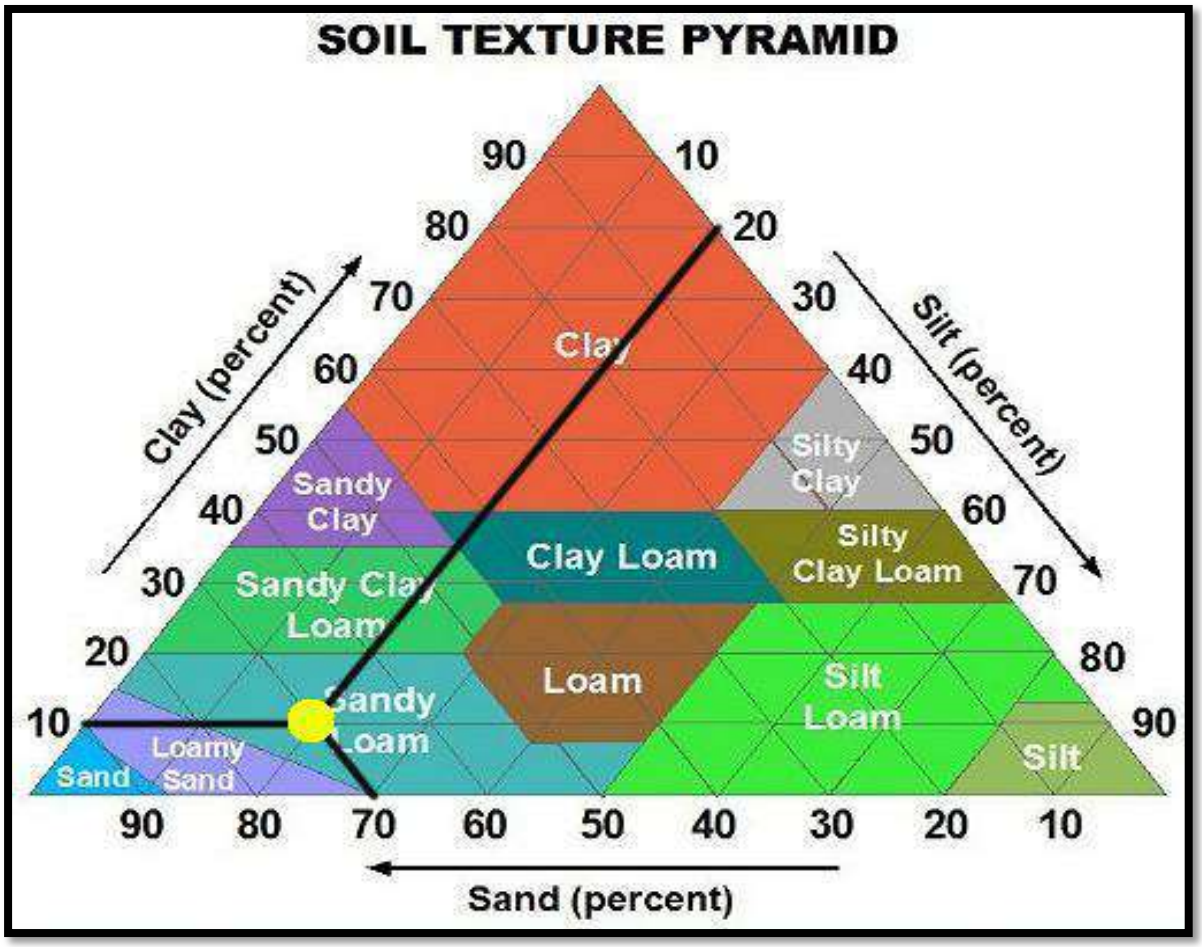


Figure-3.13: Soil Texture Diagram of the Study Area

Figure-3.14: Site Photographs of Sampling of Soil during Study Period

The soil characteristics of the area are given in **Table 3.24** below.

Table 3.24: Soil Characteristic at Ennore LNG Terminal

S.No	Parameter	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1	Texture	-	Sandy Loam	Silt Loam	Sandy Loam	Loam	Sandy Loam	Sandy Clay Loam	Sandy Loam	Loam
2	Sand	%	60.1	38.6	68.4	50.6	63.4	57.1	56.1	51.4
3	Silt	%	25.3	51.1	12.3	41.2	21.8	22.3	28.6	32.4
4	Clay	%	14.6	10.3	19.3	8.2	14.8	20.6	15.3	16.2
5	pH (1:2.5)	-	7.11	7.25	7.64	6.59	7.51	6.29	7.37	6.85
6	Electrical Conductivity (1:2)	µS/cm	711	642	504	817	656	562	608	612
7	Sodium Absorption Ratio	mg/kg	3.73	2.96	1.74	4.16	3.34	2.08	2.54	2.62
8	Porosity	%	42.7	48.8	41.5	46.5	41.9	44.2	47.7	45.8
9	Organic Matter	%	0.93	0.51	0.96	0.74	0.79	0.81	0.84	0.69
10	Bulk Density	g/cc	1.49	1.33	1.52	1.39	1.51	1.45	1.36	1.41
11	Specific Gravity	g/cc	1.49	1.33	1.52	1.39	1.51	1.45	1.36	1.41
	Available Nutrients:									
12	Nitrogen as N	kg/ha	296	196	304	244	317	286	278	262
13	Phosphorus (Olsen's) as P	kg/ha	15.1	9.6	12.4	10.2	13.1	13.4	12.8	9.8
14	Potassium as K	kg/ha	162	108	256	142	228	212	184	112

The summary of the findings on soil quality collected during March to May, 2022 is given below:

Results and discussion

The results are given in **Tables 3.24** and the standard for soil analysis is presented in **Table 3.23**. The pH of the soil extract varied from 6.29 to 7.64. In terms of soil pH the soil characteristics varied from moderately alkaline in nature. The EC varied from 504 to 817 uS/cm. Nitrogen values ranged between 196 kg/ha to 317 kg/ha. Nitrogen in the soil is better.The Phosphorus levels ranged between 9.6 to 15.1 kg/ha indicating its presence from low to medium. Soil potassium varied from 108 to 256 kg/ha indicating its presence from low to moderate.

The texture of the soil at Ennore LNG Terminal is mostly Sandy Loam. Soil particle size directly involves in deciding soil texture, porosity and infiltration capacity. The soil texture map is shown in **Figure 3.13.**

3.6 Socio-Economic Environment

3.6.1 Demography and Socio-Economics

The study of socio- economic components of environment incorporates variousfeatures viz., demographic structure, availability of basic amenities such as housing,education, medical facilities, drinking water facilities, post, telegraph and telephonefacilities, communication facilities, recreational, cultural facilities, approach to villages etc. The study of these parameters helps in identifying, predicting andevaluating the likely impacts due to the proposed project activity in that region.The study area lies within the Tiruvallur District. The District spreads over an area of about 3422 Sq.kms.

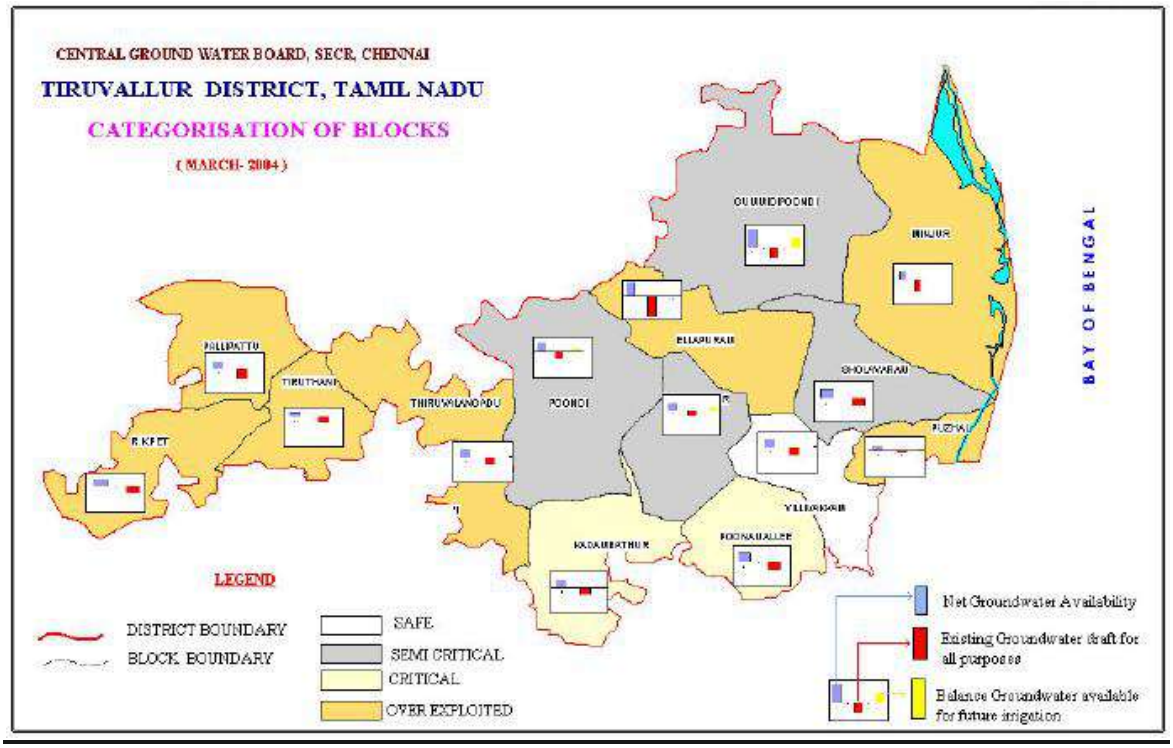


Figure-3.15: Tiruvallur District Map

Table 3.25: Administrative Division of District

S.No.	Division	Tiruvallur
1.	Revenue	4
2.	Taluka	9
3.	Blocks	14
4.	Municipalities	5
5.	Reveneue	820

Table 3.26: Habitation found within the Study Area

Habitation	
Ariyalur	Kalpakkam
Arumandai	Karungali
Attipattu	Kattoor
Attipattu Padunagar	Kattupalli
Devadanam	Kasapur
Edayanchavadi	Manali
Elandancheri	Minjur
Ennore	Nayur
Kadapakkam	Nappalayam
Kalanji	Kalpakkam
Karungali	Seemapuram
Kattoor	Somanjeri
Kattupalli	Talanguppam
Kosapur	Thangalperumbakkam
Manali	Thathamanji
Minjur	Tondiarpet
nayur	Vannipakkam
Nappalayam	Vichoor

The information on socio-economic aspects of the study area has been collected from various secondary sources, which include public offices, semi government and government offices. The proposed project study area falls under Thiruvallur District, Tamilnadu.

All developmental activities will have impact on the socio-economic conditions of the population in the region and on the quality of life. Socio-Economic Impact Assessment helps to get an idea of changes on social, economic and cultural status. Baseline data for Occupational status and Health amenities existing in the study area has been collected by personal interaction with the villagers in the study area and also from secondary sources such as census/statistics, data etc.

3.6.2 Objective

Any developmental activity will have impact on the socio-economic conditions of the population in the region and on the quality of life. Socio-Economic Impact Assessment helps to get an idea of changes on social, economic and cultural status. Keeping in view the

commitment of the organization towards social responsibility as well as to honor the sentiments and developmental needs of the local population, sample survey was done to collect qualitative information about the socio economic environment of the area.

3.6.3 Approach

In order to prepare a comprehensive report, few villages were visited for conducting sample village survey containing questions about all socio-economic aspects, including questions on the aspirations and requirements of the people for a better living. The village schedule was filled in order to capture the overall condition of the village with respect to population, human settlement, male/female ratio, literacy, occupational pattern (total workers, marginal workers, non-workers), Infrastructure resource base, viz. medical, educational, water resource, power supply, transport, police station, fire station etc..

3.6.4 Methodology Adopted for the Study

The methodology adopted for the study mainly includes review of published secondary data; The district census statistics of 2011, Thiruvallur district of Tamilnadu states for the parameters of demography, occupational structure of people within the study area of 10-km radial distance from the periphery of the proposed project site. The salient features of the demographic and socio-economic aspects are described in the following sections.

3.6.5 Average Household Size

The study area had an average family size of 3.8 persons per household in 2011. This is moderate family size and is in comparison with the other parts of the district.

3.6.6. Population Density

The density of population of Tiruvallur district works out to about 1089 persons per sq. km.

3.6.7. Sex Ratio

As per District wise Census 2011, the total population of Tiruvallur District is 37,28,104, out of which 18,76,062 are male and 18,52,042 are female. The configuration of male and female indicates that the males constitute to about 50.32% and 49.68% females of the total population. The sex ratio i.e. the number of females per 1000 males indirectly reveals certain sociological aspects in relation with female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 986 females per 1000 males.

3.6.8 Social Structure

In the study area about 1.26% population belong to Scheduled Tribes (ST) and 22.04% Scheduled Castes (SC) indicating that about 23.31% of the population in the study area belongs to socially weaker sections.

3.6.9 Literacy Levels

As per 2011 census data. The Total Literate Population of Tiruvallur District is 27, 91, 721 showing average literacy level is 84.03 %. Out of this total population 14,95,711 are male and 12,96,010 are female showing male literacy 89.69%.

3.6.10 POPULATION DETAILS:

Table 3.27: Population Details

Name	Kattu apli	Attipattu	Nandiam bakkam	Edayanc havadi	Vichoor	Vallur	Manali	Minjur	Total
Number of Households	534	2762	1511	3142	1437	2993	9331	7048	28758
Total Population	1911	11034	6268	12119	5765	11935	35248	28337	112617
Total Male	1096	5623	3156	6042	2868	6089	17911	14168	56953
Total Female	815	5411	3112	6077	2897	5846	17337	14169	55664
Population 0-6	201	1257	719	1151	600	1309	4208	2960	12405
Population SC	856	4505	2048	1402	2925	7803	8224	9374	37137
Population ST	46	299	549	5	9	29	32	58	1027
Popultation Literate	1196	8205	4817	9340	4107	9101	26268	22301	85335
Male Literate	784	4454	2542	4969	2211	5040	14133	11813	45946
Female Literate	412	3751	2275	4371	1896	4061	12135	10488	39389
Population Illiterates	715	2829	1451	2779	1658	2834	8980	6036	27282

Source: Primary census abstract 2011 & district census handbook of Thiruvallur, Tamilnadu.

3.6.11 Employment Pattern

In the census records 2011 employment pattern is distributed in 3 major parts main workers and marginal workers

Main workers: Those workers who had worked for the major part of the reference period (i.e 6 month or more) are termed as Main worker. As per 2011 census records altogether the main workers are 35125 which works out to be 31% of the total population

Main workers employment pattern

There are 4 types of main worker employment pattern (Cultivators, agricultural workers, household industry workers and other workers). Out of total main workers, cultivators were 1%, agricultural workers were 1%, household industry workers were 2% and other population were 96%.

Marginal Workers: Those workers who have not worked for the major point of the reference period (i.e less than 6 month) are termed as marginal workers. The marginal workers are 7537 which constitute 6.6%.of the total population.

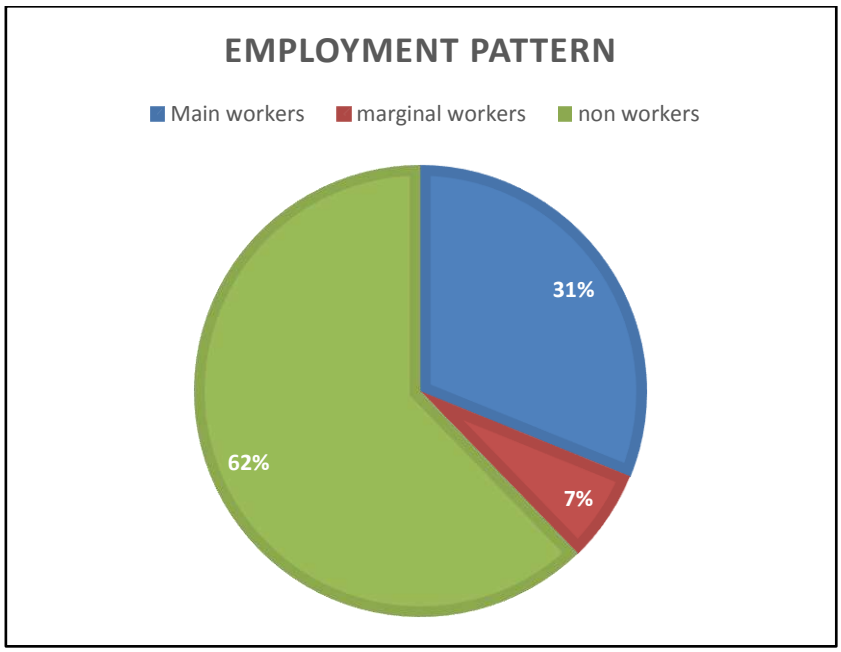
Non Workers: Those who have not engaged in any economical activities called as non workers. Non workers in the study area were 69928 i.e. non workers constitute 62% of the total population. The distribution of workers by occupation indicates that the non-workers are the predominant population.

The occupational structure of the study area is given in **Table 3.28.**

Table 3.28: Employment Pattern

Name	Total Workers	Main Workers	Marginal Workers	Non Workers
Athipattu	4072	3397	675	6962
Edayanchavadi	4219	3495	724	7900
Kattupalli	864	773	91	1047
Vichoor	2391	1781	610	3347
Nandiambakkam	2362	1899	463	3906
Vallur	4617	3662	955	7318
Manali	12745	11494	1251	22503
Minjur	11392	8624	2768	16945
Total	42,662	35,125	7,537	69,928

Source: Primary census abstract 2011 & district census handbook of Thiruvallur, Tamilnadu



3.6.12Dependency Ratio

Based on the occupational structure of the study area the dependency rate of non-workers on the workers category has been estimated at 1.64. Hence some economic generating activities should be developed so that most of the persons can engage in employment opportunities.

3.6.13 Infrastructure Facilities

Table 3.29: Infrastructure Facilities

Govt pre- Primary school	11	Primary Health Centre	4
Private Pre- Primary school	3	Primary Health sub centre	10
Govt Primary School	12	Maternity and Child welfare centre	4
Private Primary School	2	TB Clinic	4
Govt middle school	5	Dispensary	4
Private Middle School	2	Family welfare centre	4
Govt Secondary School	2	Non Government Facility	1
Private Secondary School	2	Non Government Medical	1

Source: Primary census abstract 2011 & district census handbook of Thiruvallur, Tamilnadu

3.7 Landuse & Land Cover

Landuse landcover for 500mts of the Ennore LNG Terminal project area is provided in below Figures 18 & table 30. The following are the observed Landuse Land cover features in the study area with proposed unit as epicenter and 10 km radial distance around it.

- **Water Bodies :** 17118.21 ha of the study area is covered with water logged areas, streams and backwaters
- **Builtup Land:** 751.37 ha of the study area is waste Land with villages, Industry and Town.
- **Industrial Area:** 1855.55 ha of the Study area is Industrial Area.
- **Agriculture Land:** 3525.93 ha of the study area is Agricultural land.
- **Salt Pans:** 839.77 ha of the study area is saltpans.

Table 3.30: Landuse Pattern in Hectares

Sl	Landuse	Area in Ha.
1	Agriculture Land	3525.93
2	Beach/ Seashore	177.42
3	Brick Mining	3.92
4	Builtup/ Settlement	751.37
5	Fallow Land	337.95
6	Industry	1855.55
7	Marshy/ Waterlogged	701.05
8	Open Area/ Barren Land	1704.76
9	Open Scrub	1310.49
10	Saltpan	839.77
11	Tree Cladded/ Mangrove/ Natural Vegetation	1638.68
12	Waste Land/ Badland/ Abandand Salt pan	1450.41
13	Water bodies	17118.21
Total Area in Ha.		**31415.51**

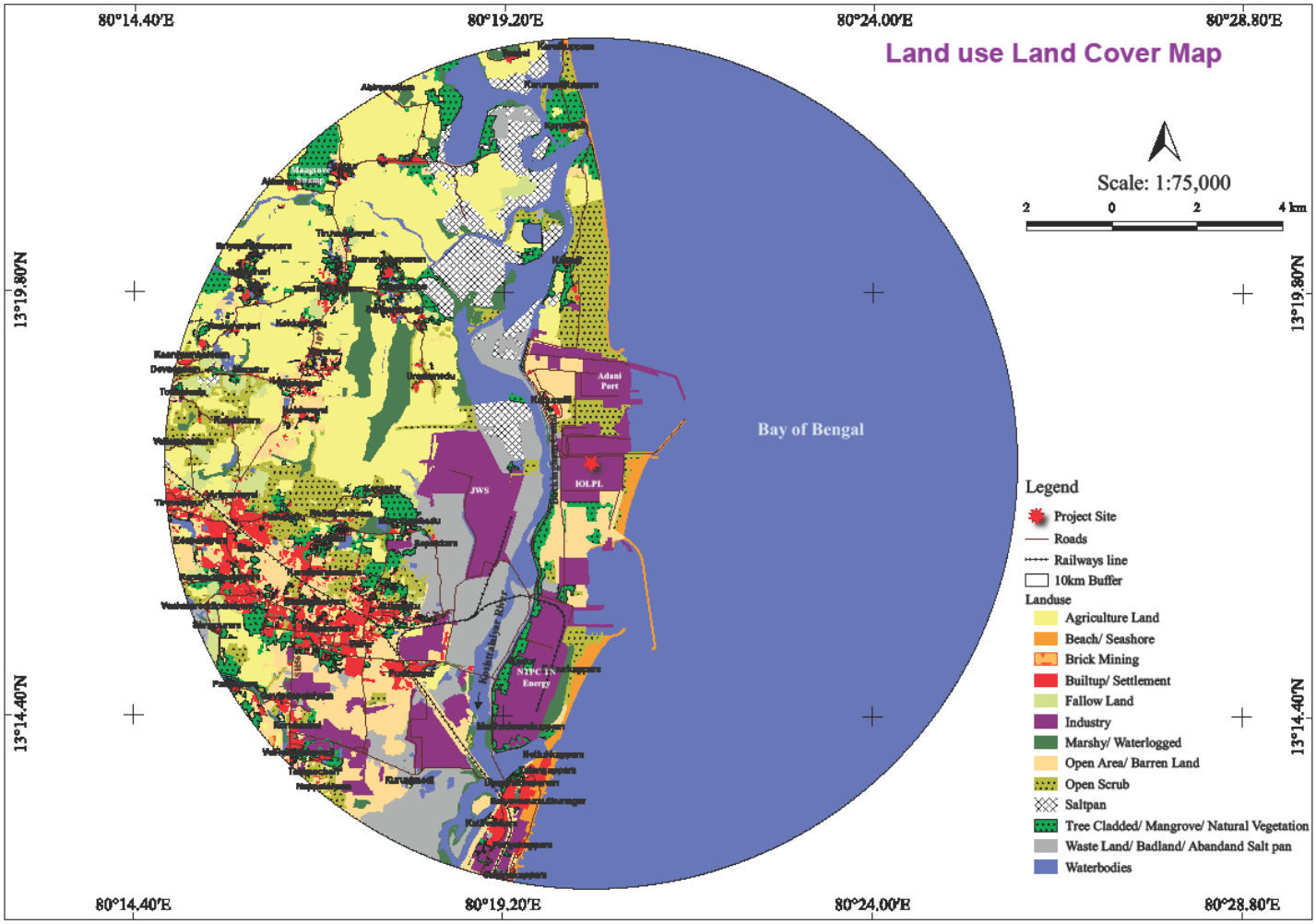


Figure: 3.16: land use land cover map of the project

3.8 Biological Environment

3.8.1 Flora

The Project area is devoid of officially designated forest areas. Patches of littoral highly denuded and degraded coastal grass and scrub with occasional trees could be seen adjoining shoreline in some sections. The, remnant littoral forests trees is constituted of Thespesia populnea, Lannea coromandelica, Ficus religiosa, Ficus hispida, Calophyllum inophyllum, Morinda coreia, Syzygium cumini, Pongamia pinnata, Azadirachta indica, Borassus flabellifer, Vitex negundo, Calamus rotang and Pandanus odoratissimus. In most areas, the natural forests are largely replaced by casuarinas, cashew (Anacardium occidentale) and coconut plantations. Other horticultural species including the palm (Borassus flabellifer) and a variety of fruit trees including jack.

The details of the floral species reported in the Study Area are given in Table 3.31**.**

Table-3.31: List of Floral Species Recorded from the Study Area

Botanical Name	Common Name	Family	Habit
Sesuvium portulacastrum	-	Aizoaceae	Herb
Mangiferaindica	Mango	Anacardiaceae	Tree
Anacardiumoccidentale	Cashew	Anacardiaceae	Tree
Holigarna arnottiana	Ranbibo	Anacardiaceae	Tree
Lanneacoromandelica	Moi	Anacardiceae	Tree
Spondia mangifera	Ambado	Anacrdiaceae	Tree
Ananascomosus	Pineapple	Annonaceae	Shrub
Thevetia peruviana	-	Apocynaceae	Shrub
Wrightiatinctoria	Kalakundo	Apocynaceae	Tree
Hollarhena antidysentric	Kudo	Apocynaceae	Tree
Alstonia scholarias	Saton	Apocynaceae	Tree
*Calamus*sp.	-	Arecaceae	Shrub
Phoenixloureiroi	-	Arecaceae	Shrub
Caryotaurens	Billemad	Arecaceae	Tree
Cocosnucifera	Naal	Arecaceae	Tree
Borassusflabellifer	Toddypalm	Arecaceae	Tree
Calotropisgigantea	Rui,Dhavirui	Asclepidiaceae	Shrub
Ageratumconyzoides	-	Asteraceae	Herb
Elephantopus scaber	-	Asteraceae	Herb
Launaea sarmentosa	-	Asteraceae	Herb
Melanthera biflora	-	Asteraceae	Herb
Botanical Name	Local/Vernacul	Family	Habit
Tridax procumbens	-	Asteraceae	Herb
Bombaxceiba	Savar	Bombacaceae	Tree
Garunga pinnata	Kakad	Burseraceae	Tree
Ceasalpinia crista	-	Caesalpiniaceae	Tree
Cassia fistula	Bayo	Caesalpiniaceae	Tree
Calaphyllus inophyllum	Oondi	Calophyllaceae	Tree
Carica papaya	Papaya	Caricaceae	shrub
Casuarina equisetifolia	Phiramgisaro	Casuarinaceae	Tree
Arthrocnemum indicum	-	Chenopodiaceae	Herb
Cyanotis axillaris	-	Commelinaceae	Herb
Ipomea pes- caprae	Maryadvel	Convolvulaceae	Herb
Mukia maderaspatana	-	Cucurbitacea	Climber
Cyperus pangorei	-	Cyperaceae	Sedge
Cyperusarenarius	-	Cyperaceae	Sedge
Derris heterophylla	-	Fabaceae	Shrub
Tephrosia purpurea	-	Fabaceae	Shrub
Adenanthera pavonia	Gunj	Fabaceae	Tree
Abrus precatorius	Gunji	Fabaceae	Climber
Pongamia pinnata	Karanji	Fabaceae	Tree

Botanical Name	Common Name	Family	Habit
Halophila beccarii	-	Hydrocharitaceae	Herb
Hyptis suaveolens	-	Lamiaceae	Herb
Leucas aspera	Tumbo	Lamiaceae	Herb
Careya arborea	Kumbiyo	Lecethidaceae	Tree
Justiciasimplex	-	Malvaceae	Herb
Sida acuta	Bala, /Chikna	Malvaceae	Herb
Hibiscus tiliaceus	Belipata	Malvaceae	Tree
Thespecia populinea	Bhendi	Malvaceae	Tree
Thespecia lampa	Ran Bhendi	Malvaceae	Shrub
Melia azedarach	Fernage Nimb	Meliaceae	Tree
Azadirachta indica	Nimb	Meliaceae	Tree
Mimosa pudica	-	Mimosaceae	Herb
Albizzia odoratissima	Kala Siras	Mimosaceae	Tree
Albizzia lebbek	Siras	Mimosaceae	Tree
Xylia xylocarpa	Zamba	Mimosaceae	Tree
Mollugo oppositifolia	-	Molluginaceae	Herb
Ficus religiosa	Pipal	Moracea	Tree
Ficus bengalensis	Vad	Moracea	Tree
Ficus arnotianna	Asti Payr	Moraceae	Tree
Artocarpus	Phanas	Moraceae	Tree
Ficus glomerata	Rumbad	Moraceae	Tree
Botanical Name	Local/Vernacul	Family	Habit
Musa paradisiaca	Keli	Musaceae	Tree
Syzgium caryophyllatum	Bhedas	Myrtaceae	Tree
Syzgium cumini	Jamun	Myrtaceae	Tree
Boerhavia diffusa L.	-	Nyctaginaceae	Herb
Nymphaea pubescens	KamalSalak	Nymphaeaceae	Herb
Nymphaea nouchali	KasturiSalak	Nymphaeaceae	Herb
Passiflora foetida	Running pop	Passifloraceae	Climber
Digitaria adscendens	-	Poaceae	Grass
Eragrostis uniloides	-	Poaceae	Grass
Saccharum spontaneum	-	Poaceae	Grass
Spinifex littoreus	Saramto	Poaceae	Grass
Eichhornia crassipes	-	Pontederiaceae	Herb
Portulaca quadrifida	Bhumygol	Portulacaceae	Herb
Acrostichum aureum	-	Pteridaceae	Fern
Zizuphus mauriliana	Boram	Rhamnaceae	Shrub
Hedyotis herbacea	-	Rubiaceae	Herb
Morinda citrifolia	-	Rubiaceae	Tree
Adina cordifolia	Hedu	Rubiaceae	Tree
Saraca indica	Asoka	Sapindaceae	Tree
Manilkara hexandra	Kirni	Sapotaceae	Tree
Mimusops elengi	Onwal	Sapotaceae	Tree
Datura innoxia	Datura	Solanaceae	Herb
Triumfetta rhomboidea	Tupkati	Tiliaceae	Herb

Botanical Name	Common Name	Family	Habit
Holoptelia integrifolia	Vavalo	Ulmaceae	Tree
Phyla nudiflora	-	Verbenaceae	Herb
Vitex altissima	Bavalgi	Verbenaceae	Shrub
Vitex negundo	Limgud	Verbenaceae	Shrub
Gmelina arborea	Shivan	Verbenaceae	Tree
Clerodendron inermi	Siritmari	Verbenaceae	Shrub

3.8.2 Fauna

The terrestrial as well as the aquatic habitats of the Project area are highly modified man made habitats with only few patches of degraded natural habitats. Wildlife in these manmade habitats is those which are resilient to the human activities. Among mammals only few small carnivore such as terrestrial rodents (Tatera indica), have been reported. Among herpetofauna, water snakes (Xenocrophispiscator, Cerberus rhyncops and Atretium schistosum), and frogs (Bufo melanostictus, Polypedates maculatus, Hoplobatrachus crassus, Hoplobatrachus tigerinus, Euphlyctis cyanophlyctis, Euphlyctis hexadactylus, Limnonectes limnocharis, Microhyl aornata, Ramanella variegata,Kaloulataprobanica and Tomopternarolandae) have been reported. Waterfowl (storks, herons and egrets) were the most common birds in the backwater estuaries.

Mammals

There are almost fifty species of mammals found in the State. Among the mammals found in the study area are common Jackal, Monkeys, Indian hare, Indian porcupine, Wildboar and the mongoose. Flying foxes are also present in large numbers. Most of these are found in the rural interior areas. No threatened, rare and endangered faunal species were present in the IUCN Red List of threatened animals. The commonly reported mammal species from the study area are given in Table-3.32**.**

Table-3.32: List of mammals reported from the study area

ZoologicalName	English Name	LocalName	IUCN status
Bandicotaindica	Bandicootrat	Kolindar	Least Concern
Canisaureaus	Jackal	Kolo	Least Concern
Cynopterus	Indianfulvousfruit	Pakho	Least Concern
Felischaus	Junglecat	Baul,	Least Concern
Funambulus	Three striped palm	Chani,Khar.	Least Concern
Herpestesedwardsii	Commongrey Mongoose	Mungoos,Munghas,	Least Concern
Hysterix indica	Porcupine	Sal,Salinder	Least Concern
Lepusnigricollis	BlacknappedHare	Soso	Least Concern
Lutralutra	CommonOtter	Udh,	Least Concern
Macaca radiata	Bonnet macaque	Khete,Makod.	Least Concern
Mus booduga	Indianfieldmouse	Undir	Least Concern
Pteropusgiganteus	FlyingFox	Pakho	Least Concern

ZoologicalName	English Name	LocalName	IUCN status
Rattusrattus	House Rat	Undir	Least Concern
Sus scrofa	Wild Boar	Ran dukar.	Least Concern

Avi-fauna

The study area has an abundant birdlife. There are some very colourful species found in the State and among these are the three common species of kingfisher: the stork-billed kingfisher is the largest and most distinctive, the breasted kingfisher and and the common kingfisher are the others. Other common and brightly coloured species include the grass-green, blue and yellow bee-eaters, the golden oriole, and the Indian roller, Hoopes, purple sunbirds, and several kinds of bulbuls, babblers and drongos. The exotic paradise flycatcher is fairly widespread in study area.

The snowy white cattle egret, the large egret and the little egret and herons are most common in the paddy fields along with cows and buffaloes. The beautiful white-bellied fish eagle, the brahminy kite and the pariah kite are birds of prey found around towns and fishing villages. The commonly reported avi-faunal species in study area are given in Table-3.33**.**

Table-3.33: List of avi-faunal species reported in study area

Scientificname	Common name
Acridotheresfuscus	JungleMyna
Acrocephalusaedon	ThickbilledWarbler
Acrocephalusagricola	PaddyfieldWarbler
Aegithina tiphia	CommonIora
Scientific name	Common name
Alcedo atthis	Common Kingfisher
Amaurornis phoenicurus	White-breasted Waterhen
Anas acuta	Northern Pintail
Anas crecca	Eurasian Teal
Anas poecilorhyncha	Spot-billed
Anas querquedula	Garganey
Anastomus oscitans	Asian Openbill
Ardea cinerea	Grey Heron
Ardea purpurea	Purple Heron
Ardeola grayii	Indian Pond-Heron
Bubulcus ibis	Cattle Egret
Cacomantis passerinus	Grey-bellied Cuckoo
Calandrella brachydactyla	Greater Short-toed Lark
Celeus brachyyurus	Rufous woodpecker
Ceryle rudis	Pied Kingfisher
Charadrius alexandrinus	Kentish plover
Charadrius dubius	Little ringed plover
Chloropsis aurifrons	Gold fronted chloropsis
Circaetus gallicus	Short-toed Snake-Eagle

Scientificname	Common name
Columba livia	Rock Pigeon
Copsychus saularis	Magpie robin
Coracina mealnoptera	Black headed cuckoo shrike
Corvus macrorhynchos	Jungle crow
Corvus splendens	House Crow
Cuculus varius	Common Hawk-Cuckoo
Cyornis tickelliae	Tickell's blue flycatcher
Cypsirus Parvus	Palm Swift
Dendrocitta vagabunda	Indian tree pie
Dendrocopos mahrattensis	Yellow-crowned Woodpecker
Dendrocopus mahrattensis	Yellow fronted pied woodpecker
Dendrocygna javanica	Lesser Whistling teal
Dicaeum agile	Thick billed Flowerpecker
Dicrurus aeneus	Bronzed Drongo
Dicrurus caerulescens	White bellied Drongo
Dicrurus macrocercus	Black Drongo
Dinopium benghalense	Lesser golden back woodpecker
Dumetia hyperythra	White throated Babbler
Elanus caeruleus	Black-winged Kite
Eremopterix grisea	Ashy-crowned Sparrow-Lark
Eumyias thalassina	Verditer flycatcher
Fulica atra	Common Coot
Gallicrex cinerea	Watercock
Gallinula chloropus	Common Moorhen
Glareola lactea	Small Pratincole
Halcyon pileata	Black-capped Kingfisher
Halcyon smyrnensis	White-throated Kingfisher
Haliaeetus leucogaster	White-bellied Fish-Eagle
Haliastur indus	Brahminy Kite
Himantopus himantopus	Black-winged Stilt
Hirundo daurica	Red rumped Swallow
Iole indica	Yellow-browed Bulbul
Lanius schach	Rufous back Shrike
Lonchura malacca	Black headed Munia
Merops orientalis	Little Green Bee-eater
Mesophoyx intermedia	Intermediate Egret
Milvus migrans	Black Kite
Motacilla madaraspatensis	Large Pied wagtail
Nectarinia asiatica	Purple Sunbird
Nectarinia zeylonica	Purple rumped Sunbird
Oriolus xanthornus	Black headed oriole
Passer domesticus	House Sparrow
Pellorneum ruficeps	Spotted Babbler
Pericrocotus cinnamomeus	Small Minivet
Ploceus philippinus	Indian Baya
Prinia inornata	Plain Prinia
Prinia socialis	Ashy Prinia

Scientificname	Common name
Pycnonotus cafer	Red vented Bulbul
Pycnonotus jocosus	Red whiskered Bulbul
Rhipidura albicollis	White throated fantail flycatcher
Saxicoloides fulicata	Indian Robin
Streptopelia chinensis	Spotted Dove
Sturnus pagodarum	Brahminy Myna
Sturnus roseus	Rosy Starling
Terpsihone paradisi	Paradise flycatcher
Tringa cinerea	Terek Sandpiper
Tringa hypoleucos	Common Sandpiper
Tringa nebularia	Common Greenshank
Turdoides striatus	Jungle Babbler
Upupa epops	Hoopoe
Vanellus indicus	Red-wattled Lapwing

Reptiles and Amphibians

The State has a large reptilian/amphibian population. This includes the ubiquitous common house gecko, a variety of frogs and the common skink, monitor lizard, Garden Lizard. Commonly observed reptilian fauna in the study area are given in **Table-3.34.**

Table-3.34: Important reptiles found in the Study Area

S. No.	Scientificname	Common name	LocalName
Snakes			
1.	*Ahaetullanasutus*	Vine Snake	Harvel, Haryali
2.	*Amphiesmastolatum*	Buff striped keel back	Yevale.
3.	*Boigaforsteni*	Forsten's Cat Snake.	
4.	*Boigatrigonata*	Common Indian Cat Snake.	
5.	*Bungarus caeruleus*	Common Indian Krait	Kaner.
6.	*Calliophis nigrescens*		Coral Snake
7.	*Coelognathus helena*	Trinket Snake	
8.	*Dendrelaphis tristis*	Bronzeback tree Snake	Naneti,Nanado.
9.	*Enhydrinaschistosa*	Hook-nosed Sea snake	
10.	*Grypotyphlops acutus*	Beaked worm snake	Sulo
11.	*Lycodon aulicus*	Common Wolf snake	Pasko
12.	*Macropisthodon*	Green keelback.	Yevale
13.	*Naja naja*	Indian Spectacled	Nag, Parro
14.	*Oligodon arnensis*	Common Kukri snake	
15	*Oligodon taeniolatus*	Variegated Kukri	
16	*Ptyas mucosa*	Indian Rat Snake	Dhaman.
17.	*Ramphotyphlops*	Brahminy worm	Telyo
18.	*Xenochropis piscator*	Checkered keelback	Yevale

S. No.	Scientificname	Common name	LocalName
19	*Xenochropis piscator*	Checkered keelback	Yevale
20	*Calotes versicolor*	Indian garden lizard	Sheddo
21.	*Chamaeleozeylanicus*	Indian chameleon	
22.	*Draco dussumieri*	Flying lizard	Pavto
23.	*Mabuyamacularia*	Bronzeskink	Shirli
24.	*Mabuyamacularia*	Bronzeskink	Shirli
25	*Duttaphrynus*	Indian toad	Manaki
26	*Hoplobatrachus*	Indian bullfrog	Bebo
27	*Euphlyctis*	Indian skipper frog	Bebki
28.	*Sphaerotheca*	Indian burrowing frog	Bebki

3.8.3 Ecology and Biodiversity

Terrestrial ecology & biodiversity study pertaining to Environmental Impact Assessment report for proposed study area was carried out in March-June 2022. The study area has flat terrain, referred as 'Coastal Plains' as commonly seen in east coastal region. Based on the topography, climatic conditions, soil types, availability of habitable area; the study area possesses different habitats like scrub land, water bodies, agricultural fields, human settlements etc. These habitats possess different characteristics which support typical composition of flora and fauna within them. Study was carried out by visiting locations, taking care that all such habitats were covered.

Listing of flora and fauna was done based on actual sighting, indirect evidences such as calls, droppings, burrows, pugmarks and other signs etc., interviewing locals, literature survey, data collected from forest officials and internet references. Villages in study area are found in hamlets situated intermittently within agricultural fields. Plantation along road side (Samania saman, Borasus Flabelifer, Peltophorum pterocarpum, Eucalyptus etc.) around the houses (Cocos nucifera, Anona squamosa, Moringa olifera etc.) in public gardens, along the seashore (Casuarina equisetifolia).

For the purpose of listing the species; open/waste area adjacent to human settlement are also considered in this habitat. Livestock animals in this region are Cattle, Buffalo, Sheep and Poultry. Faunal species like squirrel, cattle egrets, green bee eater, kingfisher etc. were observed commonly in the study area. During study period practice of sheep grazing in field, ploughing, sowing, applying of fertilizers etc. were observed.

Along with Prosopis juliflora common shrubs that are found are Calotropis gigentia, Ziziphus jujube, Acacia nilotica, Tephrosia pururia, Borasus flabelifer etc. Scrubs in study area seem to be in anthropogenic pressure because of fire wood and disposal of waste material and grazing. Such activities are not only thinning the vegetation cover but also cause threat to faunal life. Commom floral species observed in water bodies are Ipomoea aquatica, Typha, Nymphia sp., Eichhornia crassipes, Lemna etc.

3.8.4 National Park/Sanctuary

As per Ministry of Environment & Forest Notifications and local forest notifications, there are no wildlife /bird sanctuaries/ national parks/ biospheres in 10-km radius from plant site.

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.

Step1: 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.

Step2: 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:

- **HH (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	NEGLIGIBLE
Impact Is	HIGH	H	H	H	H	H
	MEDIUM	H	M	M	M	L
	LOW	M	M	L	L	L
	NEGLIGIBLE	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
	NEGLIGIBLE	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

	Physical				Biological		Socio-economic	
Activities	**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 36 months (3 years) from Zero date of Construction including mechanical completion, Commissioning and production ramp-up leading to 100% capacity utilization.

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, NOx, & SO_2 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 quantityover a day and Low consumption of power from DG sets.
Spatial	Low	Impact extends inside the proposed site
Temporal	Low	Long term effect as the construction period spans up to 4 years
Vulnerability	Low	Proposed project is located in industrial area
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 Is and temporal factors as per methodology given in Section 4.1
Overall Significance Value of Impact (S)	**Low**	By combining It 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
- Only BS-VI grade diesel fuel will be used in DG sets.

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 & Research Centre for 3 months period 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 SO_2 and NO_X

There will be no release of SO_2, PM_{10} and $PM_{2.5}$ from the proposed project. Only small quantity of NO_X emission is envisaged due to combustion of gaseous fuel in GTG. Hence, Ground Level Concentration (GLC) prediction modeling for only NOx has been only carried out. The status of SO_2 and NO_X releases from the proposed Unit are depicted below in **Tables 4.6.**

Table 4.6: Emission summary

Stack details	Stack Characteristic				SO_2 Emission (kg/hr)	NO_x Emission (kg/hr)
	Height (m)	Dia (m)	Temp (^oC)	Exit Velocity (m/s)		
201-ST-01 (GTG)	31.0	2 - 2.8	100.0 - 150.0	35 - 18	0	6.0 - 9.0
201-ST-02 (GTG)	31.0	2 - 2.8	100.0 - 150.0	35 - 18	0	6.0 - 9.0

NO_X Concentration

The isopleths for 24 hourly maximum average for NOx is shown in Figure 4.2 and the results are tabulated in Table 4.8. From the **Table 4.7**, the incremental NOx GLC (maximum 24 hr GLC) due to operation of proposed facilities is predicted as 4.6μg/m^3. This GLC is occurring outside plant boundary wall around 2.0 km from boundary in North-West direction.

Maximum 98 Percentile Baseline Value (within 10 km radius) is 26.9 μg/m3. By superimposing the same with background NO_X level, the maximum GLC observed is 31.5 μg/m^3 (24 hourly averages) which is well within the standard limits for 24 hourly averages for industrial area i.e. 80 μg/m^3.

Table4.7: Predicted values of GLC for NO_X

Description	NOx (24 hourly maximum)				
	Maximum GLC (Incremental) μg/m^3	Maximum GLC Co-ordinates (m)	Location from boundary (m)	Maximum 98th Percentile Baseline Value (within 10 km radius) μg/m^3	Resultant 98th Percentile Value μg/m^3
Release from emission sources	4.6	-800, 2400	Outside boundary wall (In N-W direction and at ~2.0 km from plant boundary)	26.9	31.5

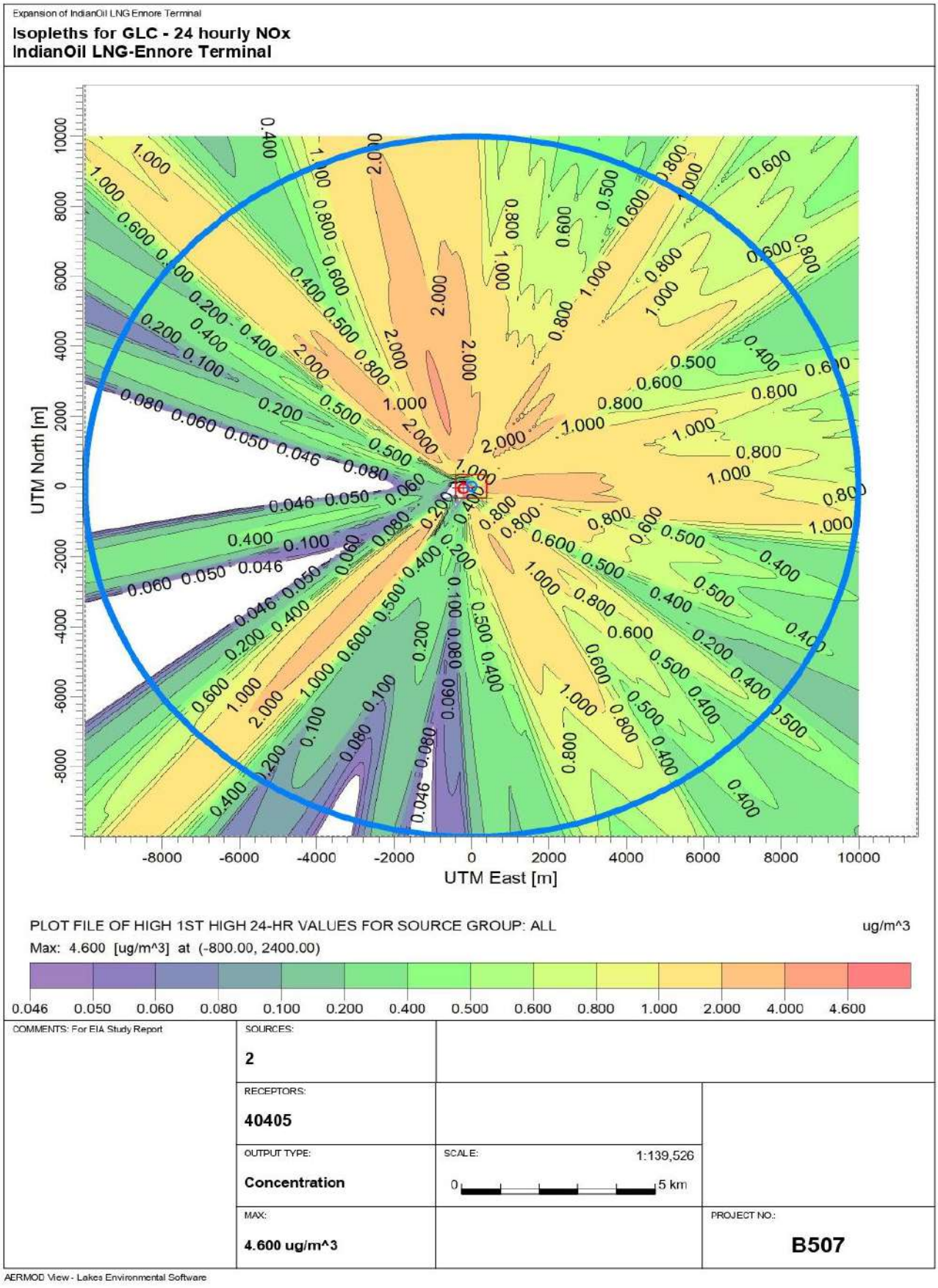


Fig.4.1 Isopleths for incremental GLC for NO_X due to proposed project

Summary of Impacts

a. The resultant NOx ambient air quality concentration post-proposed expansion project is estimated as 31.5μg/m^3 which is well within the standard limits for 24 hourly average for industrial area i.e. 80 μg/m^3.

Fugitive HC emissions of hydrocarbons are anticipated from storage tanks, valves, flanges, and seals. Hence, air quality modeling is not required for the proposed project. The significance of the impacts of air emissions on ambient air quality during operation phase is summarized in **Table 4.8.**

Table 4.8: 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 within the plant boundary
Temporal	Low	The addition of pollutants will over a day, but continuous
Vulnerability	Low	Proposed project is located in industrial area
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.
- Developing/ maintaining peripheral green belt in the proposed plant premises.
- Leak Detection and Repair (LDAR) will be in place to mitigate any fugitive emission from storage etc.

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

Water requirement for construction phase will be 200 KLD approximately and will be met from local resources. The significance of the impact of water consumption on local water resources during construction phase is summarized in **Table 4.9.**

Table 4.9: Impact of water consumption (construction phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Water requirement will be limited to 200 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 in 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

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 4.10**.

Table 4.10: 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 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

- Monitoring water usage at work sites to prevent wastage.

4.4.2 OPERATION PHASE

For proposed project, water requirement is 10m3/hr. The water will be used mainly for service water, fire water make up, horticulture and drinking water. Water will be generated in-house from atmosphere.

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 4.11.**

Table 4.11: Impact of Water Consumption (Operation Phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	Water required is limited to 10 m3/hr which will be generated from atmosphere in-house.
Spatial	Low	Water will be used for proposed project within complex only.
Temporal	High	Requirement of water will be continuous.
Vulnerability	Low	Extension project is coming with existing 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

In LNG vaporization scheme normally no liquid, gaseous and solid waste is generated. Small quantity of oily water stream generated from pump houses will be stored in an oil water sump and thereafter disposed off periodically through drums. Domestic sewage will be generated, which is collected and handled in soak-pit/ septic tank system. Rain water and firewater run-off from the process and utilities areas will be drained through storm water channel system. The impact of effluent generation during operation phase is summarized in **Table 4.12**.

Table 4.12: Impact of Effluent Generation (Operation Phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	No industrial liquid effluent will be generated/ discharged.
Spatial	Low	The impact will be limited within plant boundary.
Temporal	Low	Domestic Sewage Effluent generated will be suitably treated and reused.
Vulnerability	Low	No liquid discharge from proposed project.
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

- Tracking of treated water consumption through water meters.
- Maintaining of rainwater harvesting structures.
- Effective utilization of water.

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: 2009 Noise and Vibration Control on Construction and Operation Sites" are summarized in the **Table 4.13.**

Table 4.13: 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 4.14.**

Table 4.14: 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	Extension project is coming with existing complex.

Factors of assessment	Value of assessment	Justification
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, Air compressor 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. GTs, Pumps, Compressors & Mixers, etc. The impact of these noise emissions during operation is summarized in **Table 4.15**.

Table 4.15: 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	Extension project is coming with existing 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 set up in existing plant boundary and land owned by IOLPL.

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 4.16**.

Table 4.16: 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 36 months.
Vulnerability	Low	Extension project is coming with existing 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 4.17**.

Table 4.17: 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 36 months.
Vulnerability	Low	Extension project is coming with existing 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

From the proposed project, no solid waste and liquid wastewater generation are envisaged.

The impacts on soil quality during operation phase are summarized in **Table 4.18**.

Table 4.18: Impact on soil quality (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	No solid waste and liquid wastewater generation are envisaged.
Spatial	Low	The impact extends inside the site.
Temporal	Low	No solid waste and liquid wastewater generation are envisaged.
Vulnerability	Low	Extension project is coming with existing 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

- Littering of used drums, cans, bottles etc. at the site will be barred. For temporary storage of these will provided in earmarked place only.

4.7 BIOLOGICAL ENVIRONMENT

4.7.1 Construction phase

Impact Evaluation

The proposed facilities are to be developed in the land owned by IOLPL. 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 4.19**.

Table 4.19: 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 36 months.
Vulnerability	Low	Extension project is coming with existing complex.

Factors of assessment	Value of assessment	Justification
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:

- 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. Already 33% green belt/ cover area is maintained inside the complex. Impacts on Flora & Fauna during operation phase are summarized in **Table 4.20**.

Table 4.20: Impact on Biological Environment (operation phase)

Factors of assessment	Value of assessment	Justification
Intensity	Low	No additional emissions
Spatial	Low	Product transport is mainly through road transport/ pipeline
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

- Plant trees during operation phase as per greenbelt development plan as per land availability.
- Proper maintenance of green belt developed which provides food and habitat for local macro and micro fauna.
- Survival rate of the planted trees should be closely monitored.

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 about three years. During this phase, the major socio-economic impact will be in the sphere of generation of temporary employment of a number of personnel. It is envisaged to generate direct employment for approx. 5nos. persons and indirect employment for approx. 1000 persons due to the proposed capacity expansion project during construction phase.

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 10 cars per day.

(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 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 10 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 10 cars and 5 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 4.21**.

Table 4.21: 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

Factors of assessment	Value of assessment	Justification
		employment generation.
Temporal	Low	The impact has an medium term effect (1week – 4 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 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

Direct employment for approx. 10 people and indirect employment for approx. 10 persons is envisaged during the 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 by trucks and pipeline. The frequency of transportation will be approximately 10trucks per day.

(c) Effect on local traffic

The incremental traffic during the operational phase works out to be about 10 cars, 20 two wheelers, 10 trucks, light commercial vehicles, buses etc. per day.The impact of these activities on socio-economic environment during operation phase is summarized in **Table 4.22**.

Table 4.22: 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

- Monitoring speed and route of project-related vehicles.
- Employment opportunity may be provided to local people during operation phase considering their skills and abilities as per procedures & practices adopted by company.
- The facilities like education, medical, transportation, sanitation need to be strengthened under social welfare activity or CSR Program.

4.9 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 4.23**.

Table 4.23: Summary of Impact Evaluation in terms of Significance Value

Environmental component		Construction	Operation
Air		Low	Low
Water	Consumption of Raw Water	Low	Low
	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

ANALYSIS OF ALTERNATIVES (Technology & Site)

5.1 ANALYSIS OF ALTERNATIVE SITE

Indian Oil LNG Import, Storage, and Re-gasification Terminal is situated inside the Kamarajar Port Ltd (KPL), Vallur Post, Thiruvallur District, Chennai – 600120. The proposed expansion will be coming up inside the existing terminal complex. Tentative co-ordinates of proposed facility are Latitude: 13°17'33"N and Longitude 80°20'36"E.

This site has several favorable factors as given below:

1. Proximity to gas demand centers
2. Fully developed port with infrastructure required for LNG terminal
3. Sea, Rail and road connectivity

Alternate site for the proposed expansion project has not been studied as there is adequate space inside the existing terminal complex.

5.2 ANALYSIS OF ALTERNATIVE TECHNOLOGY

The existing technology of receiving LNG and regasifying it using glycol water mixture is a proven method of converting LNG to NG. The entire operation is carried out in a closed loop and it provides a safer and environmental friendly operation.

CHAPTER – 6

ENVIRONMENTAL MONITORING PROGRAM

6.0 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.

6.1 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 IOLPL, 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.

IOLPL had already an Engineering Group under HSE dept. to review the effectiveness of environment management system during construction and operational phase of existing and proposed project expansion. The Environmental Monitoring Cell (EMC) is a part of Engineering Group who works for monitoring and meet regularly to review the effectiveness of the EMP implementation. The data collected on various EMP measures would be reviewed by EMC and if needed corrective action will be formulated for implementation. The typical organogram of IOLPL-HSE is given below in **Figure 6.1**.

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.

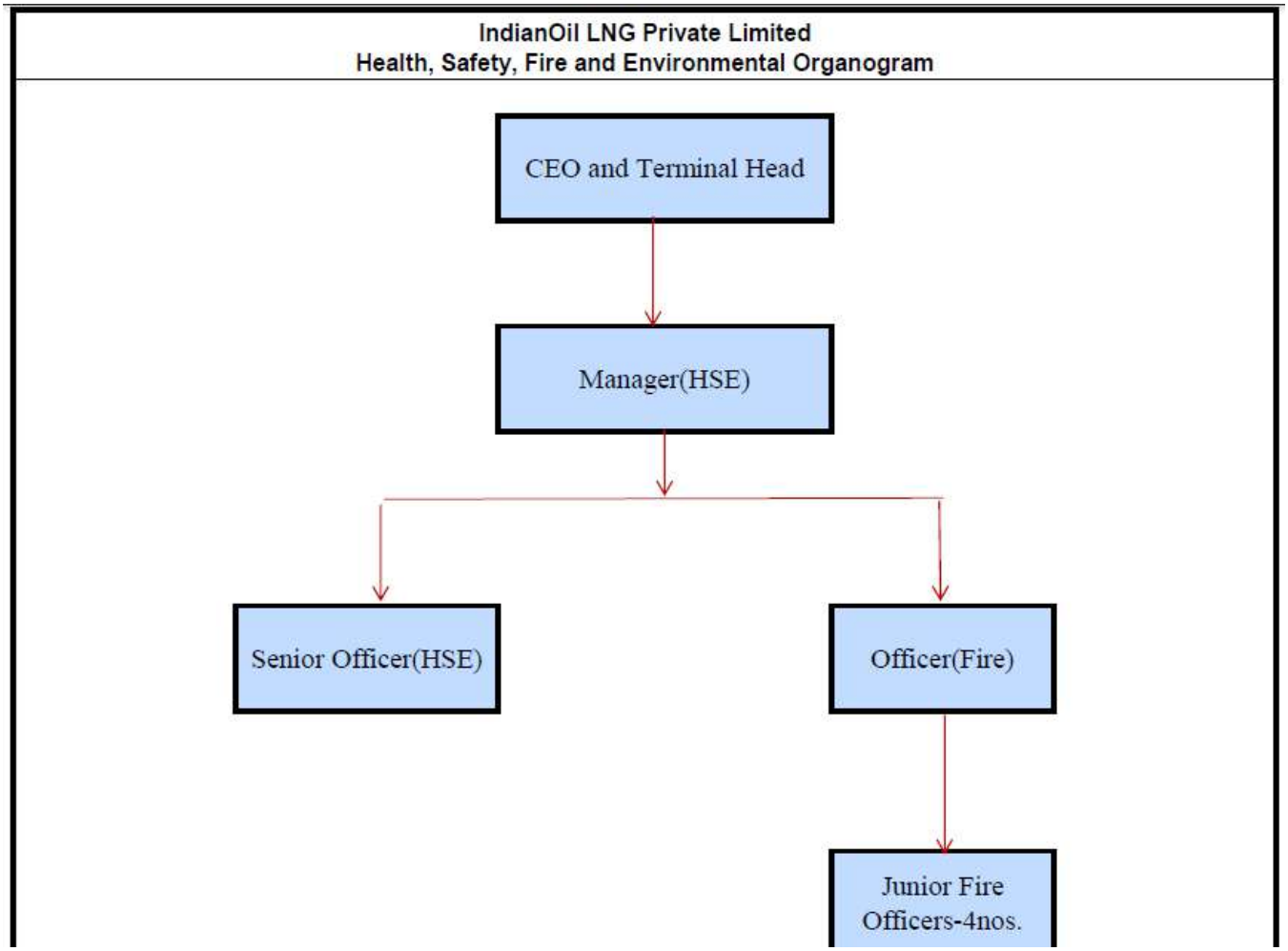


Figure 6.1 HSE Organogram of IOLPL

6.2 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 measures.

6.3 CONSTRUCTION PHASE

Chapter 4describes 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 6.1.** The implementation of monitoring will be contractor's responsibility and the supervision will be done by IOLPL.

Table 6.1 Environmental Monitoring Programme– Construction Phase (3years)

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 upwind direction and another at downwind direction, both at plant boundary. Twice in a season (except monsoon) per year	12 (2 X 2X 3)
Water	Surface Water: CPCB surface water criteria; Ground Water: IS:10500	One surface water sample in the project site per season (except monsoon). One Ground Water sample in the project site per season (except monsoon).	6 (2X 1 X 3) (If applicable)
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	6 (2 X1 X 3)
Soil	As per standard practice	At one location, in the project site. Twice in a year.	2 (1 x 2)

Note: Construction period is 3 years.

The monitoring shall be carried out through entire construction period by a MoEFCC/NABL approved laboratory.

6.4 OPERATION PHASE

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

6.4.1 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.

6.4.1.1 Work zone noise levels

IOLPL 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 6.2**). IOLPL 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 6.2 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 six selected locations.	72 samples per year (6 X 3 (shifts) per quarter x 4 quarters)
***Noise Level in Leq (A)**		

6.4.1.2 Stack gas monitoring

The flue gas coming out from the stacks will be sampled and monitored for SO_2, NO_x, CO and PM. Monitoring of the flue gases will be done as prescribed by the Tamil Nadu Pollution Control Board (TNPCB).

6.4.2 Meteorology

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

6.4.3 Ambient Air Quality

It is necessary to monitor the air quality at the boundary of the plant specifically with respect to SO_2 and NO_x. The equipment at the continuous monitoring stations will have facilities to monitor $PM_{10,}$ $PM_{2.5,}$ SO_2 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.

After the implementation of the proposed project the ambient air shall be regularly monitored as given in **Table 6.3**or as per the directives given byCPCB / TNPCB from time to time**.**

Table 6.3 Ambient air to be monitored

Sl No	Description	Number of Sampling Locations	Monitoring Frequency
1.	Ambient Air Quality	3(AAQ Stations)	Once in half yearly period, 24 hr continuous (for $PM_{2.5}$, PM_{10}, SO2 & NO_x) sampling data to be collected.
* Parameters = $PM_{2.5}$, PM_{10}, SO_2 and NO_X			

6.4.4 Waste Water from Project Site

There will be no liquid effluent disposal from the proposed project.

6.4.5 Ambient Noise

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

6.4.6 Ground Water Monitoring

No ground water is drawn and there is no discharge of any industrial effluent into Ground. Hence, ground water monitoring is not envisaged. Rain water harvesting is done within the complex.

6.4.7 Soil Quality Monitoring

Soil samples from two locationsin the project site shall be analysed once in a year.

6.4.8 Solid/Hazardous Waste Disposal

No solid waste is envisaged from this project.

6.4.9 Green Belt Development

Total area of Ennore LNG terminal is 128 acres. Existing green belt/cover area of terminal is 42.24 acres (33% of the total area). However, IOLPL will continue to carry out green belt/ cover in available spaces.

6.4.10 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 and Corporate Environment Responsibility (CER) plan will have structured interactions with the local authority to disseminate the measures planned / taken by IOLPL and also to elicit suggestions from stake-holders for overall improvement for the development of the area.

6.5 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 TNPCB and CPCB respectively, as per the requirements.

CHAPTER – 7

ADDITIONAL STUDIES

7.0. ADDITIONAL STUDIES

A Rapid Risk Assessment studies have been carried out by 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 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 or reasonably believable failure scenarios for various units 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 and cases with low chance of occurrence but having high consequence, e.g., Large Hole on the bottom outlet of Pressure Vessels. 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**.

7.1.1 MAJOR OBSERVATIONS & 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 major findings and recommendations based on maximum effect zone distance from risk analysis are summarized below:

a) Instrument Tapping Failure (20mm leak) at Discharge of Intank LP Pump: From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m at the height of 42 m and not reaching to ground. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2and 5 kW/m2 not realized at grade level. The 3 and 1 psi blast wave overpressure is realized up to 42&58 m respectively from the source point and have impact on new LNG Storage Tank.
Based on the above following is recommended:

- Provide sufficient number of hydrocarbon detectors near new LP LNG Pump for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.

b) Instrument Tapping Failure (20mm leak) at High Pressure LNG Pump Discharge: From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~82 m. LFL hazardous zone is covering the road on

the eastern, western& northern side of the HP Pumps, part of LNG Storage tanks, part of STV area, metering yard and part of existing HP LNG Pump House. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2is realized up to 63, 65, 78 & 87 m. Radiation intensity of 30 kW/m2, 25 kW/m2 covering road on western, northern & eastern side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area & part of pipeline dispatch area and 9 kW/m2 and 5 kW/m2is covering road on northern, eastern& western side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area of High Pressure LNG Pumps, part of LNG Storage Tanks. The 3 and 1 psi blast wave overpressure effect distances is realized up to102 &131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area ,LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.
Based on the above following is recommended:

- Restrict vehicle movements on the road on the eastern, western and northern side of the HP Pumps through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- The Existing Control Room is being affected due to blast overpressure generated from proposed new HP LNG pump instrument tapping failure so same needs to be revalidated through QRA to be carried out during detail engineering and accordingly suitable mitigation measure shall be adopted during detail engineering.
- Provide sufficient number of hydrocarbon detectors within the new HP LNG Pump House for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.
- Roads on northern, eastern & western side of the HP LNG Pumps are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

c) Flange Leakage (10mm leak) at High Pressure LNG Pump Discharge: From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m. LFL hazardous zone is covering the road on the eastern side of the HP Pumps. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2 , 9 kW/m2 and 5 kW/m2 is realized up to 34, 35, 42 & 47 m and covering road on eastern side of the high Pressure LNG Pump, pipe Rack on western& northern side of the HP LNG Pump, part of STV Area. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41& 55 m respectively from the source point and covering the LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the eastern side of the HP Pumps through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.

- Provide sufficient number of hydrocarbon detectors within the new HP LNG Pump House for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.
- Roads on eastern side of the HP LNG Pumps is getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

d) Flange Joint Leak (10mm leak) at Shell & Tube Vaporiser Inlet: From the consequence analysis, it was observed that LFL is realized up to a distance of ~32 m. The LFL hazardous zone is covering some part of the road on western side of the STV. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2 is realized up to 34, 35, 42 & 47 and covering the Pipe Rack on the eastern side & Road on the western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41&55 m respectively from the source point and covering HP LNG Pumps, New & Existing Metering Yard, Existing STV Unit and LNG Storage Tanks (new/existing).

Based on the above following is recommended:

- Restrict vehicle movements on the road on the western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on western side of the STV are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

e) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Inlet:

From the consequence analysis, it was observed that LFL is realized up to a distance of ~82 m. The LFL hazardous zone is covering some part of the road on northern &western side of the STV. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2 is realized up to 63, 65, 78 & 87 and covering the Pipe Rack on the eastern side & Road on the northern, eastern & western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 102&131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area, LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room, part of electrical substation.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the northern &western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on northern, eastern &western side of the STV are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

- The Existing Control Room is being affected due to blast overpressure generated from proposed new STV instrument tapping failure so same needs to be revalidated through QRA to be carried out during detail engineering and accordingly suitable mitigation measure shall be adopted during detail engineering.
- Ensure that there is minimum permanent occupancy in the electrical substation.

f) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Outlet :
From the consequence analysis, it was observed that LFL is realized up to a distance of ~17 m at height of 1m. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2 is realized up to 25, 27, 33 & 37 and covering pipe rack on eastern side & road on western side. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16 &24 m respectively from the source point.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.

g) 10mm leak at Loading Arms(near Gantry Area): From the consequence analysis, it was observed that LFL is realized up to a distance of ~38 m and covering the road on the northern & southern side of the Loading Arm. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2is realized up to 25, 25, 29 & 33 and covering the road on northern & southern side of Loading Arm & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41&56 m respectively from the source point and covering road, Pipe Rack on southern side of Loading Arm.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the northern & southern side of the Loading Arm through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on southern side of the Loading Arm are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- Provide sufficient number of hydrocarbon detectors near Loading Arm area for early leak detection and develop procedures to stop loading & inventory isolation and for safe evacuation of personnel in case of loss of containment.

h) Loading Arms Rupture (~75 mm): From the consequence analysis, it was observed that LFL is realized up to a distance of ~108 m and covering the road on the northern & southern side of the Loading Arm and part of new LNG Storage area. The jet fire radiation intensity of 30kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2is realized up to 47, 48, 59 & 67 and covering the road in northern & southern side & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 137&185 m respectively from the source point and covering road inside

facility, Pipe Rack & part of existing LNG Storage Tank & new LNG Storage Tank on southern side of Loading Arm.

Based on the above following is recommended

- This scenario shall be considered in formulating disaster management plan of the LNG Terminal as it is low failure frequency scenario

i) Instrument Tapping Failure (20mm leak) at Metering Yard: From the consequence analysis, it was observed that LFL is realized up to a distance of ~17m, it is not realized at grade. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2is realized up to 25, 27, 33 & 37 and covering the road in the eastern, western& northern side of the Metering Yard. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16&24 m respectively from the source point and covering part of STV area.

Based on the above following is recommended:

- Roads on eastern, western & northern side of the Metering Yard are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

j) Instrument Tapping Failure (20mm leak) at Hot Oil Pump Discharge: From the consequence analysis, it was observed that LFL is realized up to a distance of ~37 m and covering the road on the northern, eastern & western side of the Hot Oil Pump and N2 Package Area, Substation Building and CPP Area. The jet fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2 is realized up to 25, 26, 32 & 38 and covering the road on eastern, northern & western side Hot Oil Pump and Substation Building and CPP Area. The pool fire radiation intensity of 30 kW/m2, 25 kW/m2, 9 kW/m2 and 5 kW/m2 is realized up to 36, 40, 62&77 and covering the road on eastern, western and northern side, substation building, CPP, proposed air compressor, air compressor house and Cooling water tower. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41 & 55 m respectively from the source point and covering Substation Building.

Based on the above following is recommended:

- Restrict vehicle movements on the road on northern, eastern & western side of the Hot Oil Pump through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on eastern, western & northern side of the Hot Oil Pump are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

- Substation Building is getting affected due to jet fire , it is recommended to keep the entry and exit to the building outside the effect zone of jet fire thermal radiation intensity of 25 KW/m2for safe entry & exit to the building.
- Permanent occupancy level in the SS shall be decided based on QRA to be carried out during detail engineering.
- Ensure that the entry & exit to the substation building are outside the effect zone of pool fire thermal radiation intensity of 25 KW/m2.
- Ensure that inlet of fresh air intake of the substation building (on the eastern side of the hot oil facility) shall be opposite side of Hot oil facility with adequate numbers of detectors (HC) in the inlet fresh air duct of HVAC for detecting flammable vapors and actuating interlock for closing air damper in fresh air duct.

7.2 EMERGENCY RESPONSE & DISASTER MANAGEMENT PLAN

Emergency planning is an integral part of the overall loss control programme and is essential for our organization. The same is important for effective management of an accident to minimize the losses to the people and property, both in and around the facility. The important aspect in emergency management is to prevent by technical and organizational measures, the unintentional escape of hazardous materials out of the facility and minimize accidents and losses. Emergency planning demonstrates the organizational commitment to the safety of employees and increases our organization's safety awareness.

IOLPL has already prepared Emergency Response &Disaster Management Plan document for Ennore Terminal complex. The Emergency Response & Disaster Management Plan has been prepared as per Petroleum and Natural Gas Regulatory Board Act, 2006 and as per PNGRB amendment regulations dated17thSeptember, 2020. The ERDMP has been prepared based on the "The Gazette of India: Extraordinary Notification [F. No PNGRB/Tech/19-ERDMP/ (1)/2020]". Clause No. 3(da) – "Natural gas storage facilities including LNG terminals" of PNGRB regulations are applicable for ERDMP of IOLPL terminal.

The Emergency Response Disaster Management Plan (ERDMP) describes the organizational structure, facilities, equipment, services and infrastructure necessary to respond to the emergency situation which could have on-site as well as off-site implications at receipt, storage and dispatch points. The ERDMP covers all emergencies relating to operations and maintenance, personnel, properties including serious accidents, explosions, floods, fire and bomb threat, etc. as mentioned in the regulations. This plan also applies to those government agencies that are responsible for emergency response within the immediate area surrounding the facilities and those agencies, organizations, contractors and the facilities providing assistance to IOLPL terminal in the event of an emergency.

The terminal will maintain liaison with concerned government agencies to ensure proper understanding and interfaces regarding aspects of notification, responsibilities of personnel and resources of state and local agencies to be deployed in case of actual emergency situation. The ERDMP has covered on the following topics.

1. Short title and Commencement

2. The Emergency Response and Disaster Management Plan (ERDMP) has been prepared as per the regulations of the Petroleum and Nature Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Amendment Regulations, 2020.

3. Definitions used in the ERDMP

This Chapter provides meanings of words used in the ERDMP as per the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP)) Amendment Regulations, 2020.

4. Scope and Intent of the ERDMP

This chapter provides the Scope and Intent of the ERDMP in the Industries where it is applicable.

5. Classification of Emergencies

Emergencies which are categorized into three broad levels of seriousness i.e., Level-1,Level-2 and Level-3 and its response requirements are provided in this chapter.

6. Implementation Schedule of the ERDMP

The implementation time from notification date of Codes of Practices viz. On-site emergency Plan, Off-site emergency Plan, Resource in position, accredited third party certification of ERDMP and Testing and Mock Drill are provided in this chapter.

7. Consequences of default or Non-Compliance

This chapter provides consequences and penal provisions under the technical standards for default or non-compliance of the Act.

8. Requirements under other Statues

This chapter provides applicability/non-applicability of other statutes to the Industry.

9. Pre-Emergency Planning

This chapter provides pre-emergency planning viz. Hazard Identification, Risk Analysis and Risk Assessment, its potential dangers, consequences of its occurrences, its probabilities and its tolerable limits. It also provides the causes of man-made, natural calamities and extraneous emergencies.

10. Emergency Mitigation Measures

This chapter provides the basic requirement of ERDMP which will help in resource mobilization and incident preventing measures and procedures.

11. Emergency Preparedness Measures

This chapter provides the preliminary and subsequent action to be taken for various fire scenarios in the installation premises.

12. Response Procedures and Measures

This chapter provides the zones and mapping of the installation premises, Wind Direction& its speed, showing process lay out/flow diagrams and manpower data.

13. Emergency Organization and Responsibilities

This chapter provides the list of delegation of authority from operation personnel to emergency response personnel carry out responsibilities in emergencies as per Emergency Organization Chart and deliver their role clarity as mentioned in the ERDMP.

14. Infrastructure

This chapter provides the infrastructure facility like Emergency Control Centers (ECC) available in the Installation premises to Manage, Control and Communicate during emergencies and assembly points at safe place to de-brief after emergencies.

15. Declaration of On-site and Off-site Emergencies

This chapter provides the circumstances under which the situation is declared on-site or off-site and the situation to hand over the charge to District Authority.

16. Resources for Controlling Emergency

This chapter provides the list of various firefighting systems, firefighting equipment / facilities, Ambulance, First Aid, Medical Facilities, PPEs available and Rescue and Rehabilitation facilities available in the installation premises, with Mutual aid Members and with District and State Authorities.

17. Demographic Information

This chapter provides the industries, sensitive institutions around the installation and the population, cattle and livestock, and flora & fauna within 5 kms radius.

18. Medical Facilities

This chapter provides First Aid medicines, persons trained in first Aid available the installation and local hospitals available in and around the place.

19. Evacuation

This chapter provides the authorized persons for evacuating people from residential areas, rescue procedures, emergency exit routes, facilities/equipment available for evacuation, evacuation route and provision of food and drinking water at assembly points after transfer of people.

20. Information to Public

This chapter provides the safety measures taken in the event of emergencies made known to general public who are likely to be affected and display boards carrying do's and don'ts should be located at the outside of the installation premises as well as in the neighboring colonies.

21. Roles and responsibilities of stakeholders including external Agencies

This chapter provides the roles and responsibilities of stake holders viz. District Authorities, the Police, the Fire Service, The Health Department, the Pollution control Boards and NDRF and SDRF.

22. Reporting of the Incident

This chapter provides the incident reporting through standard form and guidelines for reporting the incident.

23. Action for Reporting of Incident by the Entity

This chapter provides the reporting of the incidents to Board, the Nodal Officer of the Board will inform the Members of the Board and co-ordinate with appropriate level in National disaster Management Authority till normalization of the situation.

24. Termination of Emergency

This chapter provides the termination of emergency would be declared through siren as per the Siren Codes defined by industry in case of Level-1, and 2. For Level-3, termination of emergencies would be declared by the District Authority.

25. Emergency Recovery Procedures

This chapter provides the series of activities to be carried out viz. information to statutory Authorities, incident investigation, damage assessment, entire experience of the incident and ambient air monitoring at the site after the incident.

26. ERDMP for Pipelines Carrying Petroleum Products and Retail Outlets

This section is not applicable to IOLPL operations as IOLPL scope is only to unload LNG, Regasification of the LNG and supplying it to IOC's SRPL who maintain the Pipeline Division

27. ERDMP for Road Transportation

This section is not applicable to IOLPL operations as IOLPL scope is only to unload LNG, Storage and Regasification of the LNG and supplying it to IOC's BD gas Division who take care of road transportation.

28. Integration of the ERDMP with National Disaster Management Authority (NDMA). This chapter provides the govt. took a definite step towards NDMP by enacting the NDMP Act, 2005 by which a proactive and comprehensive mindset towards NDMP covering all aspects from prevention, mitigation, preparedness to rehabilitation, reconstruction and recovery.

29. Miscellaneous

This chapter provides the entity to seek approval of the Board with mitigation measures proposed to be carried out for any deviation from this code of practices.

The ERDMP has been prepared based on workshop of HAZOP and Quantitative Risk Analysis study. In ERDMP report, worst possible scenarios for major failure/emergency have been identified, evaluation of their consequences have been done and a systematic plan has been devised for handling such emergency conditions.

Due to the proposed expansion project, the existing ERDMP document will be updated during it's detailed engineering stage as per Petroleum and Natural Gas Regulatory Board Act, 2006 and as per PNGRB amendment regulations dated 17th September, 2020. The following information will be incorporated in the updated ERDMP:

A. Brief Description of Plant Processes & List of the Chemicals/Hydrocarbons and their Inventories.

B. Hazard Identification & Risk Analysis including Individual Risk & Societal Risk Per Annum Based on QRA/RRA.

C. Listing out Onsite & Offsite Emergency Scenarios based on Consequence Analysis.

D. Emergency Mitigation Measures including information of Design, Inbuilt Safety System, Fire Prevention & Protection System.

E. Procedures for Onsite & Offsite Mock Drills.

F. Response procedures for Identified Onsite & Offsite Scenarios.

G. Emergency infrastructures like Emergency Control Centre, Assembly Points, Emergency Shelters etc.

H. Proposed resources for controlling emergency including medical facilities.

I. Procedure for information to public/society

J. Reporting procedure of Incidents to various Stakeholders.

K. Process Flow Diagram, Site Layout Plan, MSDS, Important Telephones Numbers Internal & External etc.

7.3 SOCIAL IMPACT ASSESSMENT AND R&R ACTION PLANS

Social Impact assessment has been carried out and details provided in cl. No. 4.8 of Chapter-4. R&R plan is not applicable for the proposed project as the land is already in possession of IOLPL and inside existing Ennore LNG Terminal complex.

7.4 PUBLIC HEARING

As per the Terms of Reference (ToR) conditions, Public Hearing for the proposed project will be held. The proceedings, outcome and measures related to Public Hearing will be incorporated in this section.

7.5 COASTAL REGULATION ZONE (CRZ) STUDY

Institute of Remote Sensing- Anna University, Chennai has carried out CRZ study and preparation of CRZ maps on approved CZMP as per CRZ Notification 2011for the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu. The High Tide Line (HTL), Low Tide Line (LTL), Ecologically sensitive areas along with setback lines indicated in approved CZMP(Approved CZMP map No: TN 111) prepared as per CRZ Notification 2011 were superimposed on to geo-referenced cadastral map to prepare a local level CRZ map at 1:4,000.

Objectives of CRZ study:

- Identification of HTL, LTL indicated in approved CZMP near proposed project activities by conducting field survey using DGPS survey.
- Mapping of ecologically sensitive entities such as Mangroves, Turtle breeding grounds, etc., indicated in approved CZMP near project site
- Superimposition of HTL,LTL, Ecologically Sensitive Areas along with project layout details on to the geo-referenced cadastral map
- Preparation of Coastal Regulation Zones by mapping setback lines as per CRZ Notification from HTL in the vicinity of project site.

Coordinates of HTL reference points:

HTL Pt	Latitude	Longitude
1	13° 18' 2.469" N	80° 20' 48.077" E
2	13° 17' 50.314" N	80° 20' 50.290" E
3	13° 17' 45.141" N	80° 21' 1.612" E
4	13° 17' 29.092" N	80° 20' 55.926" E
5	13° 17' 13.351" N	80° 20' 51.175" E
6	13° 17' 1.230" N	80° 20' 47.742" E
7	13° 17' 3.730" N	80° 19' 47.430" E
8	13° 17' 20.337" N	80° 19' 49.688" E
9	13° 17' 39.013" N	80° 19' 49.335" E
10	13° 17' 54.643" N	80° 19' 49.313" E

Project Plant Site Coordinates:

LABEL	LATITUDE	LONGITUDE
Label	Latitude	Longitude
A	13° 17' 39.793" N	80° 20' 16.493" E
B	13° 17' 39.859" N	80° 20' 43.081" E
C	13° 17' 18.714" N	80° 20' 43.138" E

The above coordinates were superimposed on approved CZMP (approved by MOEF, Government of India, New Delhi), published by Tamil Nadu state CZMA(TNCZMA) in the year 2018.Project Site falls in various CRZ categories such as CRZ - III (200m to 500m from HTL) and Outside CRZ, as per approved CZMP. CRZ zone classification for IOLPL-Ennore Terminal is provided below:

Table 7.1: CRZ Zones for the proposed project

Sl.No.	CRZ - Classification	Area in Sq.m
1	CRZ - III (200m to 500m from HTL)	112338.32
2	Outside CRZ	407454.69
	Total	519793.01

CRZ map of IOLPL-Ennore Terminal indicating proposed Facilities is provided in Figure 7.1.CRZ Report along with CRZ maps have been provided as **Annexure-VI**.

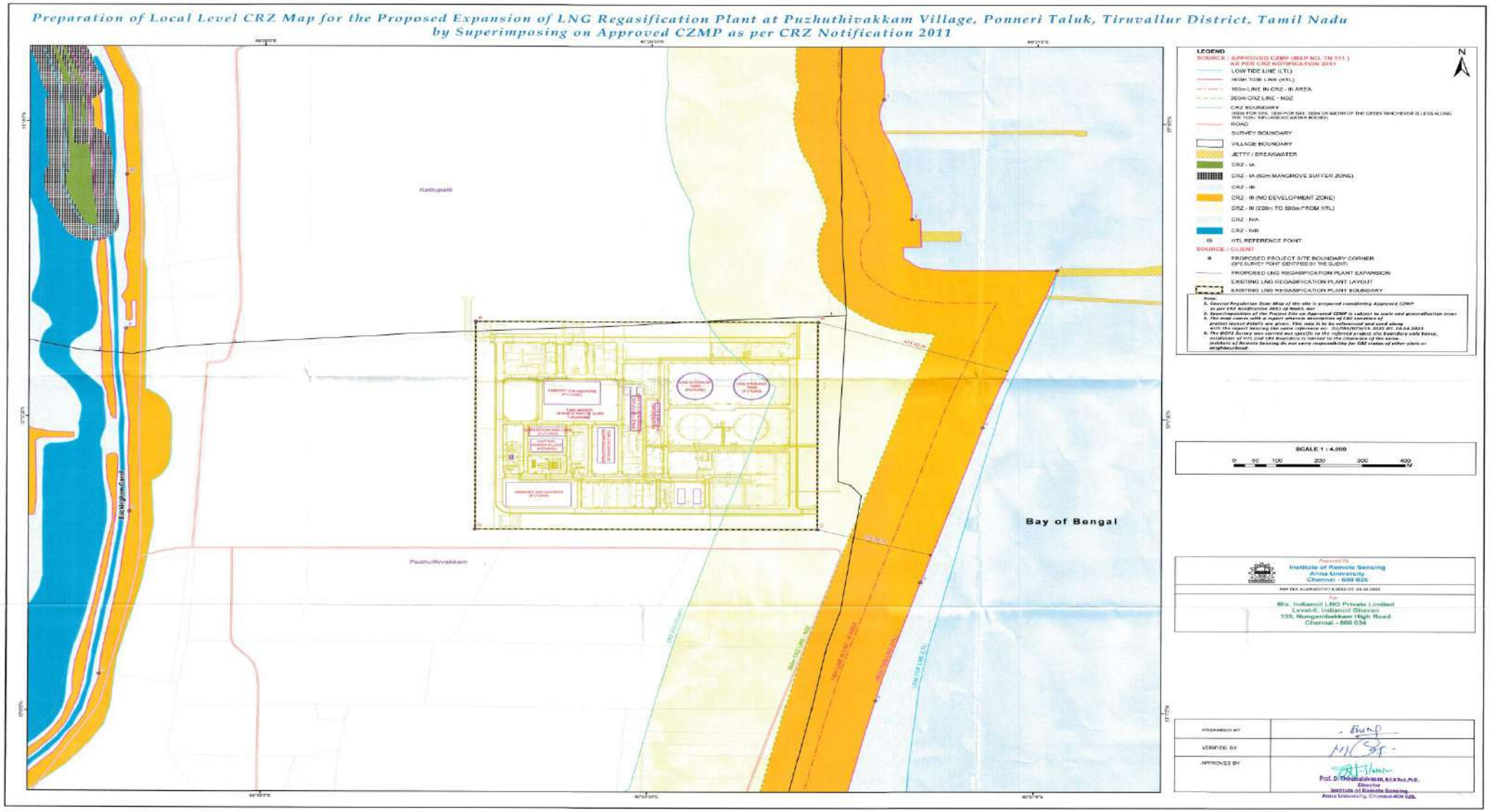


Figure-7.1: CRZ map of IOLPL-Ennore Terminal indicating proposed Facilities

CHAPTER – 8

PROJECT BENEFITS

8.0 CONTRIBUTION TO NATIONAL ENERGY NEEDS

India has been witnessing rapid urban and industrial growth in the past two decades, and with the country's current liberalization policy, this growth is expected to accelerate further. As a consequence of the rapid rate of industrialization in India, polymer products needs are increasing at an equally rapid rate and the supply-demand gap is widening and steps must be taken to address this issue. The proposed project will result in the supply of increased volumes of environmental friendly polymer products to meet the energy security of northern, western and southern region of the country.

At present, natural gas share in India is only 6% of the total energy basket of India as compared to world average of 24%. As gas is efficient and environment friendly fuel, it is aptly termed as green fuel and so preferred fuel of the century. There is a wide gap between gas demand and supply due to inadequate domestic gas discoveries and production in the present scenario. The future outlook for domestic gas production estimated by various agencies is not sufficient to meet the growing demand and the country remains gas deficient. Hence the only way to meet the growing demand of gas is to import LNG and use it. Southern states, particularly Tamil Nadu, Puducherry and some parts of Karnataka & Andhra Pradesh are starving for power due to inadequate gas supplies. Various market studies indicated that there is sufficient demand for LNG in the region and particularly major demand centers are in the vicinity of Chennai.

Moreover, in a bid to move to gas-based economy, Government of India (GoI) has been focusing on increasing the gas share in the energy mix to 15 percent from the current 6 percent by the year 2030. There is also a push to establish national gas grid and has already notified unified tariff structure with the aim to reduce the cost of natural gas for users far away from the source of natural gas and / or LNG terminal. This would act as a catalyst in boosting the consumption of natural gas in the country. The demand for RLNG in the catchment area of Ennore LNG Terminal, is expected to increase beyond 5 MMTPA by 2025-26. The additional gas demand in the catchment area would be on account of new gas based Power Plants and switching of existing Power Plants to RLNG. There will also be an increase in RLNG demand due to development of CGD networks in the districts of Tamil Nadu as well as Puducherry.

There is also a potential demand of LNG from the neighbouring countries viz. Myanmar, Bangladesh & Sri Lanka through LNG break bulking operations and offering ancillary services like gassing up & cooling down, LNG bunkering, etc. Considering the time and efforts required for construction of new storage tanks and the requirement of enhanced regasification capacity of the Terminal, Ennore LNG terminal has planned for the Expansion Project to cater to additional gas demand of the customers in Ennore catchment area in future.

8.1 SOCIO-ECONOMIC DEVELOPMENT

The proposed project would generate some direct and indirect employment opportunities during construction and operation phases. Additional manpower is envisaged for the project. Also 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. Expansion of gas infrastructure would improve the quality of life of local people by bringing in more direct / indirect employment opportunities. New industries / power plants planned to be set up based on gas will benefit from this terminal and hence likely to cause less pollution than that of coal based power plants.

Social Development is an important component of any project taken by IOLPL through CSR and CER activities. 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. Under CER/CSR activities, IOLPL will continue to carry out the benevolent activities at surrounding villages in consultation district administration.

CHAPTER 9

ENVIRONMENTAL COST BENEFIT ANALYSIS

9.0 ENVIRONMENTAL COST BENEFIT ANALYSIS

Environmental Cost-Benefit Analysis, or CBA, refers to the economic appraisal of policies and projects that have the deliberate aim of improving the provision of environmental services or actions that might affect (sometimes adversely) the environment as an indirect consequence. Vital advances have arisen in response to the challenges that environmental problems and environmental policy pose for CBA. It also compares the monetary value of benefits with the monetary value of costs in order to evaluate and prioritize issues.

The effect of time (i.e. the time it takes for the benefits of a change to repay its costs) is taken into consideration by calculating a payback period. In its simple form, CBA uses only financial costs and financial benefits.

As per EIA notification, dated:14th September, 2006, Environmental cost benefit analysis is applicable only when recommended at the scoping stage. However as per the ToR points issued by MoEF&CC, Delhi vide letter No. 11-30/2011-IA.III dated 9th September, 2021, Environmental cost benefit analysis is not recommended at the scoping stage, and has therefore not been carried out.

CHAPTER – 10

ENVIRONMENTAL MANAGEMENT PLAN

10.1 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.

10.1.1 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 10.1**.

Table 10.1 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 3: Levy and Collection of Cess Section 24: Prohibition on disposal Section 25: Restriction on New Outlet and New Discharge

Legal Instrument	Relevant articles/provisions
	Section 26: Provision regarding existing discharge of sewage 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, 2016Solid Waste Management Rules, 2016	Section 4: Duties of waste generators

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.

It shall be the responsibility of overall Project-in-charge in consultation with technical service team to ensure that all of the mitigation measures as per EIA report and EC conditions are implemented and effectively monitored.

10.2 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.

10.2.1 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.

10.2.2 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 collected and disposed through tankers using gully suckers to common waste treatment facility.
- 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 proposed project.

10.2.3 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 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

10.2.4 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) or switched off when not working)
- DG sets to be provided with acoustic enclosures and exhaust mufflers.

10.2.5 Biological environment

Construction phase (Impact significance: Low)

- Avoid cutting of tress 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.

10.2.6 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

The approximate manpower requirement will be as follows:

During Construction Phase: It is envisaged to generate direct employment for approx. 5 nos. persons and indirect employment for approx. 1000 persons due to the proposed capacity expansion project. The contractual workers will be preferably recruited locally.

10.3 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.

10.3.1 Air Environment

Operation phase (Impact significance: Low)

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

10.3.2 Water environment

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

- Tracking of consumption.
- Development of rainwater harvesting pits
- Effective utilization of water
- Zero liquid discharge concept to be adopted.

10.3.3 Land environment

Operation phase (Impact significance: Soil quality - Low)

- Developing and maintaining dedicated waste storage areas for waste cans, drums etc.

10.3.4 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.

10.3.5 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.

10.3.6 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.
- Facilities like education, medical transportation sanitation can be improved in rural areas.
- 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 areas can be improvised.
- 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.

The approximate manpower requirement will be as follows:

Direct employment for approx. 10 people and indirect employment for approx. 10 persons is envisaged during the operation phase. The contractual workers will be preferably recruited locally.

10.4 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.

10.4.1 Greenbelt Development Plan

An area of 33% of the total plot area has been already developed for green cover/belt. IOLPL has earmarked 42.24 ha out of 128 ha for green cover/belt development. IOLPL will continue to carry out green belt/ cover in available spaces. EIL has made a detailed greenbelt plan and suggested plant species for future plantation purpose. A budget of Rs. 15 Lakhs is allocated for plantation activities. IOLPL will plant and look after the planted species taking suggestions of appropriate consultant for greenbelt development.

Existing Greenbelt Area

Green belt area: 42.24 acres.

No. of trees in green belt area: 13600 Nos (Approx)

Tree species: 30 Nos

Planted tree species names:

1. Spethodia Companuleta
2. Tebubia Rosia
3. Tebubia Avalanta
4. Tespicia Populania
5. Albizia Elbbeck
6. Philtophorum
7. Terminalia Catappa (Badam)
8. Ficus Venghalensis
9. Sizinium Cumini (Naval)
10. Tebubia Argenesisa
11. Cashia Fistula
12. Cashia Nodosa
13. Cashia javanica
14. Bhahunia Furcuria
15. Legostromia

16. Cardia sebestinia
17. Aegle Marmeloes (vilvam)
18. Hardwickia vanata
19. Mimuso elangi
20. Terminalia Arjuna
21. Melia dubia
22. Jelinia africana
23. Samanya saman (Raintree)
24. Simarupa glaca
25. Anacardium Ocidental
26. Bhaunia parpuria
27. Milingtonia hartensis
28. Azadirachta indica
29. Pungamia Glabra
30. Gulmohar

Photos of existing green belt/ plantation are given below:

Figure 10.1 Photos of existing green belt/plantation

10.4.2 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.

10.4.3 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 the IOLPL plant premises. 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 10.2 Suggested species for plantation in greenbelt development

Sl. No.	Binomial name	Family	Type of planting
1.	*Anthocephaluscadamba*	Rubiaceae	All areas
2.	*Alstoniascholaris*	Apocynaceae	All areas
3.	*Bambusaarundinaceae*	Poaceae	Plant Boundary limits
4.	*Bambusa vulgaris*	Poaceae	Plant Boundary limits
5.	*Calophylluminophyllum*	Clusiaceae	All areas
6.	*Couroupitaguianensis*	Lecythidaceae	All areas
7.	*Hibiscus tiliaceous*	Malvaceae	All areas
8.	*Lagerstroemia reginae*	Lythraceae	All areas
9.	*Bassialatifolia*	Sapotaceae	All areas
10.	*Ailanthesexcelsa*	Simaroubaceae	Avenue trees
11.	*Mangiferaindica*	Anacardiaceae	Avenue trees
12.	*Manilkarahexandra*	Sapotaceae	All areas
13.	*Mimusopselengi*	Sapotaceae	All areas
14.	*Plumeriaacuminata*	Apocynaceae	Plant Boundary limits

Sl. No.	Binomial name	Family	Type of planting
15.	*Plumeria alba*	Apocynaceae	Plant Boundary limits
16.	*Plumeriarubra*	Apocynaceae	Plant Boundary limits
17.	*Syzygiumcumini*	Myrtaceae	All areas
18.	*Terminaliaarjuna*	Combretaceae	Avenue trees
19.	*Terminaliacatappa*	Combretaceae	All areas
20.	*Thespesiapopulnea*	Malvaceae	All areas
21.	*Ficusbenghalensis*	Moraceae	Avenue trees
22.	*Ficusreligiosa*	Moraceae	Avenue trees
23.	*Ficusracemosa*	Moraceae	Avenue trees
24.	*Ficusmicrocarpa*	Moraceae	Avenue trees
25.	*Murrayapaniculata*	Rutaceae	All areas
26.	*Phyllanthus emblica*	Euphorbiaceae	All areas
27.	*Tectona Grandis*	Verbenaceae	Avenue trees
28.	*Cassia siamea*	Caesalpiniaceae	Avenue trees
29.	*Cassia fistula*	Caesalpiniaceae	Avenue trees

The species suggested here are commonly seen in and 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.

10.4.4 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.

The total construction period is 36 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 18 months. The second phase will start after 18 months and continue upto 36 months.

10.5 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 EPCM contractor. It is mandatory for EPCM contractor to develop site/project specific HSE Policy, HSE Plan, HSE management system for complete EPCM phase of the project. The various HSE requirements/Deliverables that will be developed is given in **Table 10.3**.

Table10.3 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 MoEFCC)
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

10.5.1 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 HSE 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

HSE manager as appropriate. All such records will be reviewed for corrective and preventive action.

10.5.2 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 HSE Manager. As indicated in **Table 10.3**, 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 HSE manager as appropriate. Also as indicated in **Table 10.3** of Sl. No. 6.3, all such records will be reviewed for corrective and preventive action.

10.5.3 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 HSE records will be documented for the total water used for construction 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 HSE 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.

10.5.4 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 Tamil Nadu 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.

10.5.5 Biological Environment

The existing green belt shall be maintained inside the complex. More plantation will be carried out in open areas depending upon availability.

10.6 IMPLEMENTATION OF EMP IN OPERATION PHASE

All the operation activities are undertaken, controlled and managed by EPCM contractor. It is mandatory for EPCM 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.

10.7 OCCUPATIONAL HEALTH

For the proposed project, action plan for the implementation Health and Safety provisions as per the Factories Act, 1948and Rules framed there under 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.

10.7.1 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 the Factories Act 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.

Periodic medical checkup of contract and subcontract workers working at hazardous processes is done as per clause 68 T of Factory's Act.

10.8 DEVELOPMENT STRATEGY OF THE AREA

10.8.1 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.

10.8.2 Energy Conservation measures

Properly implemented energy saving measures may reduce considerable amount of expenditure and emission of greenhouse 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.
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 street lighting shall be controlled by staggering of putting on-off of lights in particular sequence.

10.8.3 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.

10.8.4 CSR Activities

Under Corporate Social Responsibility, IndianOil LNG Private Limited is committed to work towards improvement in the living conditions of local population near the terminal, particularly in the areas of health & hygiene, civic amenities, infrastructure, education & training, water supply etc. Major CSR activities are given below along with photographs.

Table 10.4 Major CSR activities carried out by IOLPL

Activity	Year	Details
Free Eye screening, Testing and Surgery camp at Athipattu village, Chennai.	2018	As a part of CSR, IOLPL conducted its first Free Eye screening, Testing and Surgery camp conducted at Athipattu village, Chennai on 13-06-2018. The camp was headed by Mr. Ramu K, Chief Executive Officer and Mr. Chandrababu, Chief General Manager inaugurating the camp. A total of 166 people participated in the camp and 59 of them were identified with problems in vision. Out of 59 people, free Cataract Surgery done for 9 patients, Reading Glass provided for 14 patients and Bifocal glasses issued for 36 patients.
Providing Public Address System to Government Higher Secondary School, Kattupalli	2018	Government Higher Secondary school, Kattupalli has requested IOLPL to provide Public Address system for the school. The total strength of the school is 200 and they don't have any means of Public Address system for mass communication. On the request, IOLPL has provided Public Address system comprising of Mixer Amplifier, 2 nos. Speakers and 2 nos. microphones at a cost of Rs.21,045/- (Rupees Twenty One Thousand and Forty Five only) on 05-12-2018.
Supply of School Desk Bench to Government School, Kattupalli	2019	Government school, Kattupalli requested IOLPL to provide desk & benches for classes from LKG to 5th standard. On the request

		IOLPL decide to provide desks & benches as basic amenities like benches, desks, toilets, safe drinking water etc., play a key role in ensuring attendance of children in the schools. 55 no's of desks and benches were provided to government school, Kattupalli at a cost of Rs 2,60,485 (Rupees Two Lakhs Sixty Thousand four hundred and eighty five only) on 12th January 2019.
Supply of Essential Commodities to Nearby Local Villages	2020	The covid-19 infectious disease triggered by coronavirus has been declared as global pandemic by the World Health Organisation (WHO). This contagious disease has tremendously disrupted the socio-economic circumstances of the whole world. As a socially responsible organisation IOLPL have provided essential commodities to 3200 families on 16th April 2020 &11th May 2020 to Local population of nearby villages at a cost of Rs 9 lakhs.
Contribution of ₹ 10 lakhs in Covid relief fund toTiruvallurdistrictadministratortocombatthe Covid-19 pandemic	2021	Under CSR schemes to combat COVID -19 and overcome the pandemic situation prevailing to Tiruvallur District, IOLPL-CEO Mr. K. Ramu handed over Rs. 10 lakhs DD to District Administrator Tiruvallur on 28.05.2021 along with the presence of Mr. J. Sivakumar COO - IOLPL & Mr. Manivannan - General Manager - District Industries Centre Tiruvallur.

Figure 10.2: CSR activities carried out by IOLPL

10.8.6 Corporate Environment Responsibility (CER)

Corporate Environmental Responsibility (CER) refers to a company's duties to abstain from damaging natural environments. The idea of corporate environmental responsibility (CER) is for humans to be more aware of the environmental impact and counteract their pollution/carbon footprint on the natural resources.

The following factors cover the environmental implications of a company's operations:

- Eliminate waste and emissions
- Maximize the efficient use of resources and productivity
- Minimize activities that might impair the enjoyment of resources by future generations.

Various CER activities will be carried out by IOLPL in the vicinity of proposed project area with budget during next 3 years. Rs. 2.5 Crores has been provisioned as budget for CER activities. The CER fund will be spent in various CER activities during 3 years of construction period like Solar Lighting/Solar pump (Irrigation) system, Drinking Water Facilities, greenbelt development, Air quality monitoring in surrounding area etc. in addition to the cost envisaged for the implementation of the EIA/EMP which includes the measures for the pollution control, environmental protection and conservation.

10.9 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 10.5 &10.6**. The total estimated budget for implementation of EMP is worked out as Rs. 40 Lakhs towards capital cost and Rs.14 Lakhs towards recurring cost per annum.

Table 10.5: Budget of Environmental Management Plan (Capital Cost)

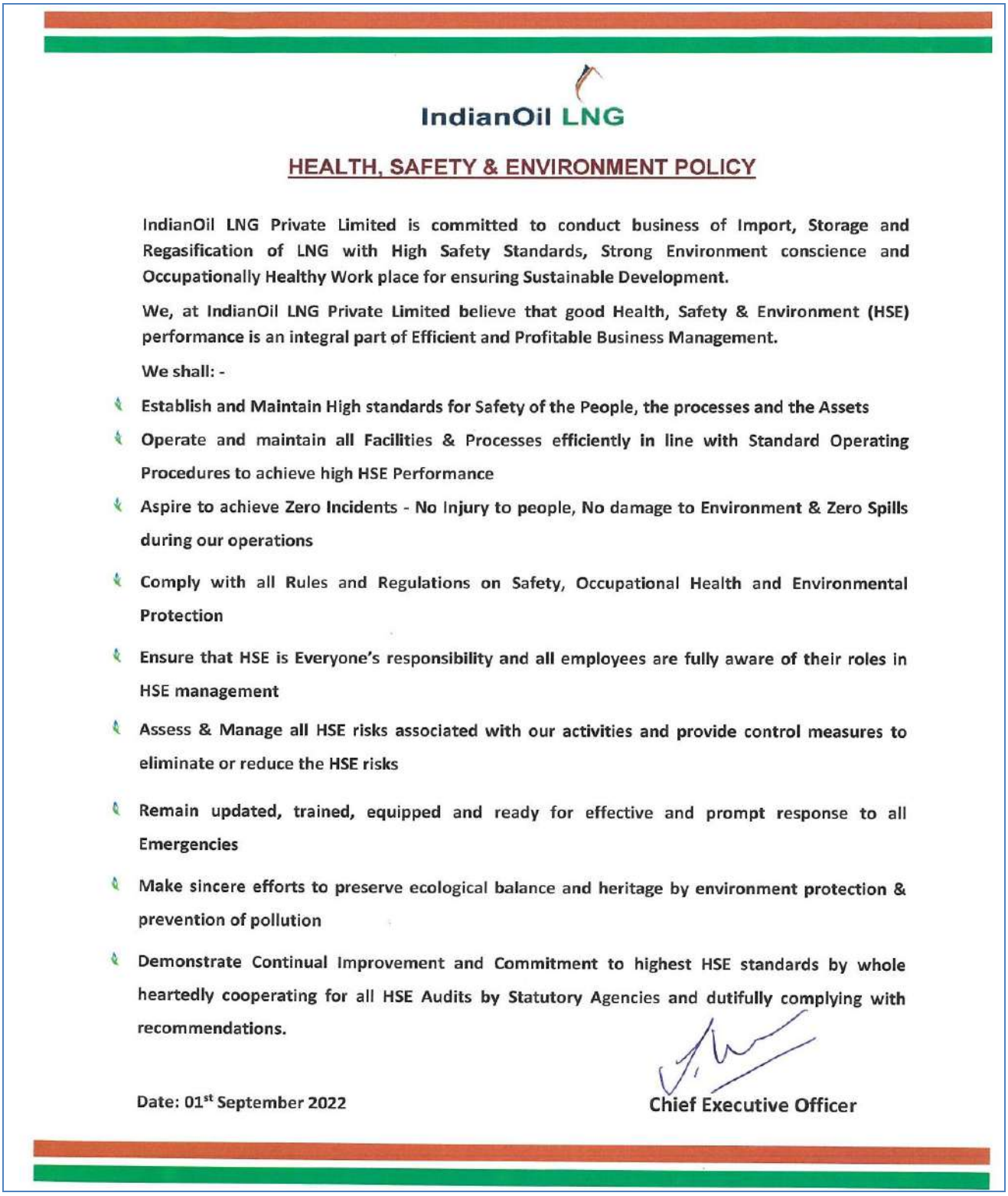
Sl. No.	Activity	Cost
		(Rupees in Lakhs)
1.0	**Air Environment**	
1.1	Plantation Activities (Trees and Shrubs)	**15.0**
1.2	Online analyzers & monitoring	**10.0**
2.0	**Noise Environment**	
2.1	Additional Plantation Activities	Included in 1.1
2.2	Audiometric tests	**5.0**
3.0	**Water Environment**	
3.1	Rain water Harvesting pits	**5.0**
3.2	Sampling & analysis of Ground water & surface water source	**0.0**
4.0	**Land Environment**	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Soil Sampling & analysis	**5.0**
5.0	**Biological Environment**	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Capital Cost)	**40.0**

Table 10.6: Budget of Environmental Management Plan (Recurring Cost per Annum)

Sl. No.	Activity	Cost
		(Rupees in Lakhs)
1.0	**Air Environment**	
1.1	Additional Plantation Activities (Trees and Shrubs)	**5.0**
1.2	Air quality monitoring	**3.0**
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	**2.0**
3.2	Sampling & analysis of Ground water & surface water source	**0.0**
4.0	**Land Environment**	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Soil Sampling & analysis	**2.0**
5.0	**Biological Environment**	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Recurring Cost per Annum)	**14.0**

10.10 Quality, Safety, Health and Environmental Policy

IOLPL is having well documented Quality, Environment, Occupational Health and Safety Policy for the workers and employees who are working in the Plant. The HSE policy of IOLPL is given below as **Figure 10.3.**



IndianOil LNG

HEALTH, SAFETY & ENVIRONMENT POLICY

IndianOil LNG Private Limited is committed to conduct business of Import, Storage and Regasification of LNG with High Safety Standards, Strong Environment conscience and Occupationally Healthy Work place for ensuring Sustainable Development.

We, at IndianOil LNG Private Limited believe that good Health, Safety & Environment (HSE) performance is an integral part of Efficient and Profitable Business Management.

We shall: -

- Establish and Maintain High standards for Safety of the People, the processes and the Assets
- Operate and maintain all Facilities & Processes efficiently in line with Standard Operating Procedures to achieve high HSE Performance
- Aspire to achieve Zero Incidents - No Injury to people, No damage to Environment & Zero Spills during our operations
- Comply with all Rules and Regulations on Safety, Occupational Health and Environmental Protection
- Ensure that HSE is Everyone's responsibility and all employees are fully aware of their roles in HSE management
- Assess & Manage all HSE risks associated with our activities and provide control measures to eliminate or reduce the HSE risks
- Remain updated, trained, equipped and ready for effective and prompt response to all Emergencies
- Make sincere efforts to preserve ecological balance and heritage by environment protection & prevention of pollution
- Demonstrate Continual Improvement and Commitment to highest HSE standards by whole heartedly cooperating for all HSE Audits by Statutory Agencies and dutifully complying with recommendations.

Date: 01st September 2022

Chief Executive Officer

Figure 10.3 HSE policy of IOLPL

CHAPTER – 11

SUMMARY & CONCLUSION

11.0 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

11.1 PROJECT DESCRIPTION

Indian Oil Corporation Limited (IOCL) is the largest commercial undertaking in India is engaged in the business of refining, transportation and marketing the Petroleum products and Regasified LNG (RLNG). IOLPL, a Joint Venture company of Indian Oil Corporation Limited, was incorporated in the year 2015 under the Companies Act, 2013 for implementation of Ennore LNG Import, Storage, and Re-gasification Terminal Project. The project is having 5 MMTPA capacity with provision to expand up to 10 MMTPA inside the Kamarajar Port (formerly known as Ennore Port), Chennai. IOLPL commenced construction of the terminal in 2015 and completed/commenced operations in 2019. Ennore LNG Terminal is the first LNG terminal on the eastern coast of India.

The gas demand in the Ennore catchment area expected to increase more than 5 MMTPA in 2025-26. Considering this, IOLPL proposes to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA (20 MMSCMD to 40 MMSCMD). This LNG import and regasification terminal of enhanced capacity will supply clean energy (RLNG/GAS) and shall spur industrial growth in the states of Tamil Nadu, Andhra Pradesh and Karnataka. The re-gasified LNG will be distributed to power generation plants, fertilizer plants and other industrial units. The gas will also be made available for City gas distribution, including transport sector, commercial sector and for cooking in houses (PNG – Piped Natural Gas). The proposed Ennore terminal expansion project will involve 20 MMSCMD LNG import, storage and Regasification with some provision of space for future expansion.

In this regard, IOLPL submitted proposal (vide Proposal No.: IA/TN/IND2/226614/202109) dated 02 Sep 2021 to obtain Terms of Reference (TOR). Ministry of Environment, Forests and Climate Change (MoEFCC) prescribed standard TOR (No.11-30/2011-IA.III dated 9th September, 2021) for preparing environment impact assessment report and obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006 under activity “6(a) Oil & gas transportation pipeline (crude and refinery/petrochemical products), passing through national parks / sanctuaries /coral reefs /ecologically sensitive areas including LNG Terminal”. The proposed project will also require Coastal Regulatory Zone (CRZ) clearance.

IOLPL has entrusted the task of preparation of Environmental Impact Assessment (EIA) and Rapid Risk Assessment (RRA) studies of proposed Ennore Terminal extension to M/s Engineers India Limited (EIL). EIL is an accredited consultant for carrying out EIA studies by Quality Council of India for activity: “6(a) Oil & gas transportation pipeline (crude and refinery/petrochemical products), passing through national parks / sanctuaries /coral reefs /ecologically sensitive areas including LNG Terminal”.

For this proposed expansion project, no additional land is required. All the proposed project facilities are coming up within the existing LNG Terminal complex area. Total area

of Ennore LNG terminal is 128 acres. Existing green belt area of terminal is 42.24 acres. The estimated cost of the Expansion Project is approximately Rs. 3,400 Crores. The Expansion Project is expected to be completed and commissioned in 54 months.

11.2 EXISTING FACILITIES AT ENNORE LNG TERMINAL

This existing terminal receives imported LNG through LNG carriers / ships at a dedicated LNG Berth already constructed inside Kamarajar Port and stores the same at cryogenic temperature of (-) 162 Degree Celsius and near atmospheric pressure i.e. 180 mbar in 2 nos of above ground full containment type LNG tanks of 180000 cubic meter capacity each. Full containment tanks are the safest tanks for LNG storage. LNG stored at (-) 162 deg C in the tank is pumped with the help of In-tank Low Pressure pumps at 10 bar to flood the suction of High-Pressure pumps, which in turn pressurize LNG to 90 bar. LNG is then converted into gas in the Shell and Tube type Vaporisers by indirect heating with room temperature water-glycol mixture. The glycol is mixed with the water so that water should not freeze and stop circulating through the equipment. The regasified LNG (RLNG) at 90 bar pressure is then sent to the metering & send-out pipeline for transportation to various customers through a cross country pipeline network. The proposed project envisages expansion of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA.

The Ennore LNG terminal is currently designed considering the following sendout:

- Normal – 20 MMSCMD
- Minimum – 8 MMSCMD
- Design – 24 MMSCMD (20% overdesign)

The terminal is designed to provide sendout gas at the battery limit at the following pressures:

- Normal operating pressure: 88 bar g
- Minimum operating pressure: 80 bar g
- Maximum pressure: 95 bar g

The send out temperature at normal operating pressure will be minimum $5^{o}C$.

11.3 OVERVIEW OF PROPOSED EXPANSION PROJECT

As part of the expansion work, 2 additional Full Containment type LNG storage tanks of 180,000 cubic meter capacity each, High Pressure LNG Pumps, Vaporizers, Atmospheric Air Heaters, Captive Power Plant will be installed along with allied piping, civil, instrumentation and electrical jobs apart from requisite utilities and ancillary facilities. Piping will be fabricated with fully welded joints avoiding flange connections, thereby reducing the risk of leakages. Boil-off gas generated in the Terminal will be converted to liquid LNG with the help of re-condenser and sent back into the system. Safety and integrity of the facilities is ensured through gas detection and alarm system installed in the Terminal. The expansion project will be built in line with the international/ Indiancodes and standards in terms of construction and safety. For expansion of the Terminal, no

additional land is required since the additional LNG storage tanks as well as regasification facilities will be located within the existing premises of the Terminal at Kamarajar Port, Ennore, Tamilnadu.

The proposed configuration to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10 MMTPA (20 MMSCMD to 40 MMSCMD) has the following broad scope of the project facilities:

1. LNG Storage Tanks and associated facilities
2. Regasification facilities including Offsites and Utility Blocks

The expansion project will have the following components:

- Storage system: LNG storage tanks and Low pressure LNG pumps
- High pressure LNG pumps
- Vaporizers
- Metering system and Final Pressure Adjust
- Fuel gas / natural gas system
- Relief and drain system

Tie-ins and plot plan space will be considered to cover the future expansions.

11.4 EXISTING ENVIRONMENTAL STATUS

Environmental baseline data from site was collected during March, 2022 to May, 2022 by M/s J.P. Test & Research Center, Ghaziabad (Accredited by NABL) for Meteorology, air, water, noise, traffic and soil environment. The description of the existing environmental status of the study area (10 km radius area)including Socioeconomic and Biological environment is summarized here.

11.4.1 Air Environment

Ambient air quality monitoring has been carried out at 8 nos. locations. PM_{10}, $PM_{2.5}$, SO_2, NO_x, HC (Methane & Non Methane) CO, Benzene at eight (08) different locations during 12 weeks. A summary of the same is given in **Table 11.1.**

Table 11.1 Summary of Baseline data of AAQs

Particular	98thPercentile value	NAAQStandard
PM_{10}	57.8-78.7 µg/m^3	100
$PM_{2.5}$	26.7-39.5µg/m^3	60
SO_2	9.8-15.7 µg/m^3	80
NO_X	17.7-26.9 µg/m^3	80
CO	0.47-1.04 mg/m^3	02 (8 hourly)
Total HC	<0.5 mg/m^3	-

All parameters were found well within limits prescribed by NAAQS 2009.

11.4.2 Water Environment:

For assessing the quality of water around the 10 km radius of the proposed plant, 12 samples were collected from the nearby villages. Out of 12 samples, six (06) samples were collected from the surface water and the remaining six (06) samples were collected from ground water source of the nearby villages.The analysis results for 16 locations collected during the study period are:

The pH of the ground water samples varying from 6.68 to 8.02, which is well within the IS 10500 limits 6.5 to 8.5. Total dissolve solids (TDS) were found in the range of 1225 mg/l to 3560 mg/l. TDS of water samples collected at Minjur and Manali were found to be exceeding IS 10500 desirable limit 500 mg/l& permissible value of 2000mg/l. Hardness concentration was ranging from 458 to 846 mg/l, Hardness of water samples collected at Minjur and Manali were found to be exceeding the IS 10500 permissible limit 600 mg/l. Chloride concentration were found in the range of 462 to 1605 mg/l. Chloride of water samples collected at Manali were found to be exceeding the IS 10500 desirable limit 250 mg/l& permission limit 1000 mg/l.Sulphates concentration was found to be range of 108 to 246 mg/l. which is indicating that in all the ground water samples Sulphate concentration is not exceeding the IS 10500 desirable limit 200 mg/l.

The pH of the surface water samples collected during study period is found well the tolerance limit as per Class C with pH ranges of 6.62 to 7.43. The BOD value ranges from 3.2 mg/l to 9.4 mg/l. The Dissolved Oxygen value ranges between 6.4 mg/l to 7.2 mg/l. The Coliforms value ranges between 3.2×10^3 to 6.3×10^3 MPN/100 ml.

11.4.3 Noise Environment:

Noise levels were monitored at 8 different locations within the study area. The hourly recorded noise level at various locations in the study area shows fluctuations because of change in traffic movement and other man made sources. The equivalent values of noise levels are 49.4 dB to 58.6 dB (A) during daytime and 36.1 dB to 41.0 dB (A) during night time during study period. However, these noise levels are found to be well within the permissible Commercial limits (Daytime: 65 dB (A) and Nighttime: 55 dB (A)) of CPCB.

11.4.4 Soil Environment:

Soil samples were collected from 8 locations within the study area out of which one location falls within the proposed site area. The pH of the soil extract varied from 6.29 to 7.64. In terms of soil pH the soil characteristics varied from moderately alkaline in nature. The EC varied from 504 to 817 uS/cm. Nitrogen values ranged between 196 kg/ha to 317 kg/ha. Nitrogen in the soil is better. The Phosphorus levels ranged between 9.6 to 15.1 kg/ha indicating its presence from low to medium. Soil potassium varied from 108 to 256 kg/ha indicating its presence from low to moderate.

The texture of the soil near site is mostly Sandy Loam. Soil particle size directly involves in deciding soil texture, porosity and infiltration capacity.

11.4.5 Biological Environment:

The Project area is devoid of officially designated forest areas. Patches of littoral highly denuded and degraded coastal grass and scrub with occasional trees could be seen adjoining shoreline in some sections. The, remnant littoral forests trees is constituted of Thespesia populnea, Lannea coromandelica, Ficus religiosa, Ficus hispida, Calophyllum inophyllum, Morinda coreia, Syzygium cumini, Pongamia pinnata, Azadirachta indica, Borassus flabellifer, Vitex negundo, Calamus rotang and Pandanus odoratissimus. In most areas, the natural forests are largely replaced by casuarinas, cashew (Anacardium occidentale) and coconut plantations. Other horticultural species including the palm (Borassus flabellifer) and a variety of fruit trees including jack.

The terrestrial as well as the aquatic habitats of the Project area are highly modified man made habitats with only few patches of degraded natural habitats. Wildlife in these manmade habitats is those which are resilient to the human activities. Among mammals only few small carnivore such as terrestrial rodents (Tatera indica), have been reported. Among herpetofauna, flapshell turtle (Lissemys punctata), water snakes (Xenocrophispiscator, Cerberus rhyncops and Atretium schistosum), Dog-faced water snake (Cerberus rhynchops), and frogs (Bufo melanostictus, Polypedates maculatus, Hoplobatrachus crassus, Hoplobatrachus tigerinus, Euphlyctis cyanophlyctis, Euphlyctis hexadactylus, Limnonectes limnocharis, Microhyl aornata, Ramanella variegata, Kaloulataprobanica and Tomopternarolandae) have been reported. Waterfowl (storks, herons and egrets) were the most common birds in the backwater estuaries.

As per Ministry of Environment & Forests Notifications and local forest notifications, there are no wildlife/bird sanctuaries/national parks/ biospheres in 10-km radius from plant site.

11.4.6 Socio-economic conditions:

The socio-economic 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. The study of socio- economic components of environment incorporates various features viz., demographic structure, availability of basic amenities such as housing, education, medical facilities, drinking water facilities, post, telegraph and telephone facilities, communication facilities, recreational, cultural facilities, approach to villages etc. The study of these parameters helps in identifying, predicting and evaluating the likely impacts due to the proposed project activity in that region.

The study area lies within the Tiruvallur District. The District spreads over an area of about 3422 Sq.kms. The study area had an average family size of 3.8 persons per household in 2011. The density of population of Tiruvallur district works out to about 1089 persons per km2. As per District wise Census 2011, the total population of Tiruvallur District is 37,28,104, out of which 18,76,062 are male and 18,52,042 are female. The configuration of male and female indicates that the males constitute to about 50.32% and 49.68% females of the total population. In the study area about 1.26% population belong to Scheduled Tribes (ST) and 22.04% Scheduled Castes (SC) indicating that about 23.31% of the population in the study area belongs to socially weaker sections. As per 2011 census data. The Total Literate Population of Tiruvallur District is 27, 91, 721 showing average literacy level is 84.03 %. Out of this total population 14,95,711 are male and 12,96,010 are female showing male literacy 89.69%.

11.5 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 11.2**.

Table 11.2: Impact Identification Matrix

	Physical				Biological		Socio-economic	
Activities	**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 11.3**.

Table 11.3: Impact Assessment Summary

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

Biological	Low	Low
Socio-Economic	Low	Low

11.6 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

11.6.1 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, NOx, & SO_2 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.
- 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
- Only BS-VI grade diesel fuel will be used in DG sets.

Operation Phase

Impacts (Significance - Low)

- There will be no release of SO2, PM10 and PM2.5 from the proposed project. Only small quantity of NOX emission is envisaged due to combustion of gaseous fuel in GTG.
- The resultant NOx ambient air quality concentration is estimated as 31.5μg/m3 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.
- Developing/ maintaining peripheral green belt in the proposed plant premises.
- Leak Detection and Repair (LDAR) will be in place to mitigate any fugitive emission from storage etc.

11.6.2 WATER ENVIRONMENT

Construction Phase

Impacts (Significance –Low)

- Water requirement for construction phase will be 200 KLD approximately and will be met from local resources.
- The effluent streams will be generated regularly that will comprise ofSewage, grey water from site areaand washing water for vehicle and equipment maintenance area.

Mitigation Measures

- Monitoring water usage at work sites to prevent wastage.

Operation Phase

Impacts (Significance –Low)

- For proposed project treated water requirement is 10 m3/hr. The water will be used mainly for service water, fire water make up, horticulture and drinking water.
- Water will be generated in-house from atmosphere.

Mitigation Measures

- Tracking of treated water consumption through water meters.
- Installation of rainwater harvesting structures.
- Maximum Utilization of Treated Water.
- Zero liquid discharge concept to be adopted.

11.6.3 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.
- Avoiding unnecessary engine operations (e.g. equipments with intermitted use switched off when not working).
- Ensuring DG sets, Air compressor sets are provided with acoustic enclosures and exhaust mufflers.

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 plant complex. 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.

11.6.4 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 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.

Operation Phase

Impacts (Significance – Low)

From the proposed project, no solid waste and liquid wastewater generation are envisaged.

Mitigation Measures

- Littering of used drums, cans, bottles etc. at the site will be barred.
- For temporary storage of these will provided in earmarked place only.

11.6.5 BIOLOGICAL ENVIRONMENT

Construction Phase

Impacts (Significance –Low)

The proposed facilities are to be developed in the land owned by IOLPL. The project site does not harbor any fauna of importance. Therefore, the impact of construction activities on fauna will be insignificant.

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.

Operation Phase

Impacts (Significance – Low)

The impacts due to proposed project activities during operation phase shall be limited. Already 33% green belt/ cover area is maintained inside the complex.

Mitigation measures

- Plant trees during operation phase as per greenbelt development plan as per land availability.
- Proper maintenance of green belt developed which provides food and habitat for local macro and micro fauna.
- Survival rate of the planted trees should be closely monitored.

11.6.6 SOCIO-ECONOMIC ENVIRONMENT

Construction Phase

Impacts (Significance – Low)

- The construction phase is expected to span for about three years. During this phase, the major socio-economic impact will be in the sphere of generation of temporary employment of a number of personnel. It is envisaged togenerate direct employment for approx. 5 nos. persons and indirect employment for approx. 1000 persons due to the proposed capacity expansion project during construction phase.
- 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 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 turningrequirements 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.

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.
- Direct employment for approx. 10 people and indirect employment for approx. 10 persons is envisaged during the operation phase.

Mitigation measures

- Monitoring speed and route of project-related vehicles.
- Employment opportunity may be provided to local people during operation phase considering their skills and abilities as per procedures & practices adopted by company.
- The facilities like education, medical, transportation, sanitation need to be strengthened under social welfare activity or CSR Program.

11.7 BUDGET FORENVIRONMENTAL MANAGEMENT PLAN (EMP)

Considering all EMP measures suggested above, cost is worked out for implementation of environmental management plan and is given in **Table 11.4**. The total estimated budget for implementation of EMP is worked out as Rs. 40 Lakhs towards capital cost and Rs. 14 Lakhs towards recurring cost per annum.

Table 11.4: Budget of Environmental Management Plan (Capital Cost)

Sl. No.	Activity	Cost
		(Rupees in Lakhs)
1.0	**Air Environment**	
1.1	Plantation Activities (Trees and Shrubs)	**15.0**
1.2	Online analyzers & monitoring	**10.0**
2.0	**Noise Environment**	
2.1	Additional Plantation Activities	Included in 1.1
2.2	Audiometric tests	**5.0**
3.0	**Water Environment**	
3.1	Rain water Harvesting pits	**5.0**

3.2	Sampling & analysis of Ground water & surface water source	**0.0**
4.0	**Land Environment**	
4.1	Additional Plantation Activities	Included in 1.1
4.2	Soil Sampling & analysis	**5.0**
5.0	**Biological Environment**	
5.1	Additional Plantation Activities	Included in 1.1
	Budget for EMP (Capital Cost)	**40.0**

11.8 ADDITIONAL STUDIES

11.8.1 RAPIDRISK ASSESSMENT

RRA involves identification of various potential hazards & credible or reasonably believable failure scenarios for various units based on their frequency of occurrence & resulting consequence.

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 have been carried out for the following cases:

a) Instrument Tapping Failure (20mm leak) at Discharge of Intank LP Pump
b) Instrument Tapping Failure (20mm leak) at High Pressure LNG Pump Discharge
c) Flange Leakage (10mm leak) at High Pressure LNG Pump Discharge
d) Flange Joint Leak (10mm leak) at Shell & Tube Vaporiser Inlet
e) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Inlet
f) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Outlet
g) 10mm leak at Loading Arms (near Gantry Area
h) Loading Arms Rupture (~75 mm)
i) Instrument Tapping Failure (20mm leak) at Metering Yard
j) Instrument Tapping Failure (20mm leak) at Hot Oil Pump Discharge

Based on the findings, suitable recommendations for mitigation of the hazard/risk have been suggested.

11.8.2 EMERGENCY RESPONSE &DISASTER MANAGEMENT PLAN

Emergency planning is an integral part of the overall loss control programme and is essential for our organization. The same is important for effective management of an accident to minimize the losses to the people and property, both in and around the facility. The important aspect in emergency management is to prevent by technical and organizational measures, the unintentional escape of hazardous materials out of the facility and minimize accidents and losses. Emergency planning demonstrates the organizational commitment to the safety of employees and increases our organization's safety awareness.

IOLPL has already prepared Emergency Response & Disaster Management Plan document for Ennore Terminal complex. The Emergency Response & Disaster

Management Plan has been prepared as per Petroleum and Natural Gas Regulatory Board Act, 2006 and as per PNGRB amendment regulations dated17thSeptember, 2020. The ERDMP has been prepared based on the "The Gazette of India: Extraordinary Notification [F. No PNGRB/Tech/19-ERDMP/ (1)/2020]". Clause No. 3(da) – "Natural gas storage facilities including LNG terminals" of PNGRB regulations are applicable for ERDMP of IOLPL terminal.

The Emergency Response Disaster Management Plan (ERDMP) describes the organizational structure, facilities, equipment, services and infrastructure necessary to respond to the emergency situation which could have on-site as well as off-site implications at receipt, storage and dispatch points. The ERDMP covers all emergencies relating to operations and maintenance, personnel, properties including serious accidents, explosions, floods, fire and bomb threat, etc. as mentioned in the regulations. This plan also applies to those government agencies that are responsible for emergency response within the immediate area surrounding the facilities and those agencies, organizations, contractors and the facilities providing assistance to IOLPL terminal in the event of an emergency.

Due to the proposed expansion project, the existing ERDMP document will be updated during it's detailed engineering stage as per Petroleum and Natural Gas Regulatory Board Act, 2006 and as per PNGRB amendment regulations dated 17th September, 2020. The following information will be incorporated in the updated ERDMP:

A. Brief Description of Plant Processes & List of the Chemicals/Hydrocarbons and their Inventories.
B. Hazard Identification & Risk Analysis including Individual Risk & Societal Risk Per Annum Based on QRA/RRA.
C. Listing out Onsite & Offsite Emergency Scenarios based on Consequence Analysis.
D. Emergency Mitigation Measures including information of Design, Inbuilt Safety System, Fire Prevention & Protection System.
E. Procedures for Onsite & Offsite Mock Drills.
F. Response procedures for Identified Onsite & Offsite Scenarios.
G. Emergency infrastructures like Emergency Control Centre, Assembly Points, Emergency Shelters etc.
H. Proposed resources for controlling emergency including medical facilities.
I. Procedure for information to public/society
J. Reporting procedure of Incidents to various Stakeholders.
K. Process Flow Diagram, Site Layout Plan, MSDS, Important Telephones Numbers Internal & External etc.

11.8.3 COASTAL REGULATION ZONE (CRZ) STUDY

Institute of Remote Sensing- Anna University, Chennai has carried out CRZ study and preparation of CRZ maps on approved CZMP as per CRZ Notification 2011for the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri

Taluk, Tiruvallur District, Tamil Nadu. The High Tide Line (HTL), Low Tide Line (LTL), Ecologically sensitive areas along with setback lines indicated in approved CZMP(Approved CZMP map No: TN 111) prepared as per CRZ Notification 2011 were superimposed on to geo-referenced cadastral map to prepare a local level CRZ map at 1:4,000.

Objectives of CRZ study:

- Identification of HTL, LTL indicated in approved CZMP near proposed project activities by conducting field survey using DGPS survey.
- Mapping of ecologically sensitive entities such as Mangroves, Turtle breeding grounds, etc., indicated in approved CZMP near project site
- Superimposition of HTL,LTL, Ecologically Sensitive Areas along with project layout details on to the geo-referenced cadastral map
- Preparation of Coastal Regulation Zones by mapping setback lines as per CRZ Notification from HTL in the vicinity of project site.

Coordinates of HTL reference points:

HTL Pt	Latitude	Longitude
1	13° 18' 2.469" N	80° 20' 48.077" E
2	13° 17' 50.314" N	80° 20' 50.290" E
3	13° 17' 45.141" N	80° 21' 1.612" E
4	13° 17' 29.092" N	80° 20' 55.926" E
5	13° 17' 13.351" N	80° 20' 51.175" E
6	13° 17' 1.230" N	80° 20' 47.742" E
7	13° 17' 3.730" N	80° 19' 47.430" E
8	13° 17' 20.337" N	80° 19' 49.688" E
9	13° 17' 39.013" N	80° 19' 49.335" E
10	13° 17' 54.643" N	80° 19' 49.313" E

Project Plant Site Coordinates:

LABEL	LATITUDE	LONGITUDE
Label	Latitude	Longitude
A	13° 17' 39.793" N	80° 20' 16.493" E
B	13° 17' 39.859" N	80° 20' 43.081" E
C	13° 17' 18.714" N	80° 20' 43.138" E

The above coordinates were superimposed on approved CZMP (approved by MOEF, Government of India, New Delhi), published by Tamil Nadu state CZMA(TNCZMA) in the year 2018.Project Site falls in various CRZ categories such as CRZ - III (200m to 500m from HTL) and Outside CRZ, as per approved CZMP. CRZ zone classification for IOLPL-Ennore Terminal is provided below:

Table 11.5: CRZ Zones for the proposed project

Sl.No.	CRZ - Classification	Area in Sq.m
1	CRZ - III (200m to 500m from HTL)	112338.32
2	Outside CRZ	407454.69
	Total	519793.01

11.9 PROJECT BENEFITS

In a bid to move to gas-based economy, Government of India (GoI) has been focusing on increasing the gas share in the energy mix to 15 percent from the current 6 percent by the year 2030. There is also a push to establish national gas grid and has already notified unified tariff structure with the aim to reduce the cost of natural gas for users far away from the source of natural gas and / or LNG terminal. This would act as a catalyst in boosting the consumption of natural gas in the country. The demand for RLNG in the catchment area of Ennore LNG Terminal, is expected to increase beyond 5 MMTPA by 2025-26. The additional gas demand in the catchment area would be on account of new gas based Power Plants and switching of existing Power Plants to RLNG. There will also be an increase in RLNG demand due to development of CGD networks in the districts of Tamil Nadu as well as Puducherry. There is also a potential demand of LNG from the neighbouring countries viz. Myanmar, Bangladesh & Sri Lanka through LNG break bulking operations and offering ancillary services like gassing up & cooling down, LNG bunkering, etc. Considering the time and efforts required for construction of new storage tanks and the requirement of enhanced regasification capacity of the Terminal, Ennore LNG terminal has planned for the Expansion Project to cater to additional gas demand of the customers in Ennore catchment area in future.

The proposed project would generate some direct and indirect employment opportunities during construction and operation phases. Additional manpower is envisaged for the project. Also 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. Expansion of gas infrastructure would improve the quality of life of local people by bringing in more direct / indirect employment opportunities. New industries / power plants planned to be set up based on gas will benefit from this terminal and hence likely to cause less pollution than that of coal based power plants. Social Development is an important component of any project taken by IOLPL through CSR and CER activities.

11.10 CORPORATE ENVIRONMENT RESPONSIBILITY (CER)

Various CER activities will be carried out by IOLPL in the vicinity of proposed project area with budget during next 3 years. Rs. 2.5 Crores has been provisioned as budget for CER activities. The CER fund will be spent in various CER activities during 3 years of construction period like Solar Lighting/Solar pump (Irrigation) system, Drinking Water Facilities, greenbelt development, Air quality monitoring in surrounding area etc. in addition to the cost envisaged for the implementation of the EIA/EMP which includes the measures for the pollution control, environmental protection and conservation.

CHAPTER-12

DISCLOSURE OF CONSULTANTS

12.1 GENERAL INFORMATION

Name of Organization: Engineers India Limited

Address: HOD (EIA, Sustainability & Water Department)
Environment, Water & Safety (EWS)Division
Tower-I, Ground floor,
R&D Centre, Engineers India Limited,
Gurugram(On NH-8),
Haryana-122001
Telephone No. :0124-2891235
Email:pk.goel@eil.co.in

12.2 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 Gurugram, 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 EILIOT 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.

12.3 EIL'S VISION

To be a world-class globally competitive EPC and total solutions Consultancy Organization.

12.4 EIL'SMISSION

- 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.

12.5 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.

12.6 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.

12.7 HSE POLICY OF EIL

- EIL is committed to conduct its business operations ensuring compliance with Health, Safety & Environment (HSE) requirements of its customers, applicable codes, standards, procedures, engineering practices as well as legal statutory requirements.

- EIL aims to minimize Environmental Impact of its operations by conserving resource, reducing waste generation and preventing pollution across its areas of operations.
- EIL endeavors to identify HSE risks of its operations and mitigate the same to prevent injuries and ill health to the stakeholders involved in its activities.
- While developing Culture and promoting HSE awareness across the Organization, EIL regularly reviews its performance for continual improvement in HSE management system with due consultation and participation of its employees and concerned stakeholders.

12.8 ENVIRONMENTAL POLICY OF EIL

- Ensure compliance with applicable environmental requirements/ regulations during design and delivery of products / service and our operations.
- Consider environmental impact in decision making processes.
- Promote/develop green technologies for sustainable development.
- Promote environmental awareness among all employees.
- Adopt the adage-reduce, reuse and recycle in all our operations.

12.9 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.

12.10 DETAILS OF CONSULTANT'S ACCREDITATION

National Accreditation Board for Education and Training (NABET) - under the Accreditation Scheme for EIA Consultant Organizations has accredited EIL as an EIA consultant for 13 EIA Sectors, vide NABET notification dated 21.12.20 and certification No.- NABET/EIA/1922/RA 0189_Rev.01 which is valid till 22.11.2023. The list of sectors for which the accreditation has been accorded by NABET is given in **Figure - 12.1**. The same can also be referred from the NABET website "https://nabet.qci.org.in/eia.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, Gurugram

EIL Office Complex, Sector-16, On NH-48, Gurugram- 122001

The organization is accredited as Category-A under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
2.	Thermal power plants	4	1 (d)	A
3.	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
4.	Petroleum refining industry	10	4 (a)	A
5.	Chemical fertilizers	16	5 (a)	A
6.	Petro-chemical complexes	18	5 (c)	A
7.	Distilleries	22	5 (g)	A
8.	Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal	27	6 (a)	A
9.	Isolated storage & handling of Hazardous chemicals	28	-	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: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated Nov 20, 2020 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/20/1578 dated Dec 21, 2020. The accreditation needs to be renewed before the expiry date Engineers India Limited, Gurugram following due process of assessment.

Sr. Director, NABET
Dated: Dec 21, 2020

Certificate No.
NABET/EIA/1922/RA 0189_Rev 01

Valid till
Nov 22, 2023

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

Figure. 12.1: EIL Accreditation Certificate by NABET

12.11 Details of EIA Coordinators (EC) :

Details of EIA Coordinator (For Sector 27 as per NABET Scheme & Category 6 (a) as per MoEFCC- 2006 EIA Notification) are as follows:

Name: Mr. Parveen Kumar Goel
Contact: Mob - 9891305309
Email: pk.goel@eil.co.in

12.12 Details of Functional Area Experts (FAE's) &Team Members (TM's):

a) FUNCTIONAL AREA EXPERTS:

Functional Areas	Name of the Experts	Involvement (Period &Task)
SHW	Parveen Kumar Goel	January, 2022 – January, 2023 Identification of storage and disposal of solid and hazardous waste for the proposed plant. Finalization of Environmental Monitoring Plan and Environmental Management Plan.
WP	Himanshu Gupta	January, 2022 – January, 2023 Review of proposed water requirements for the project, verification and analysis of baseline data, impact assessment, and preparation of environmental management plan for water environment.
SE	Raja Subbaratna Prasad	January, 2022 – January, 2023 Review of demographic characteristics, and supervision of baseline data collection. Collection and analysis of perception study carried out for the proposed project.
AP	Jayant Kumar Joshi	January, 2022 – June, 2022 Identification of impacts on AP and suggesting mitigation measures.
EB	Dr. Chiranjibi Pattanaik	January, 2022 – January, 2023 Site visit, collection and analysis of baseline data on flora and fauna, impact assessment of the study area, preparation of greenbelt development plan and environmental management plan for biological environment.
HG	Parveen Kumar Goel	January, 2022 – January, 2023 Assessment of ground water sampling results with available secondary data to interpret current conditions.

Functional Areas	Name of the Experts	Involvement (Period &Task)
AQ	Raja Subbaratna Prasad	January, 2022 – January, 2023 Verification of meteorological data, air quality assessment, air quality impact assessment, Preparation of environmental management plan for the proposed project
NV	S.V.R. Subramanyam	January, 2022 – January, 2023 Verification of noise and traffic baseline data, impact assessment, Preparation of environmental management plan for noise environment.
LU	Raja Subbaratna Prasad	January, 2022 – January, 2023 Assessment of soil sampling results with available secondary data to interpret current conditions.
RH	M.V.A.K. Bhargava Ram	January, 2022 – January, 2023 The Rapid Risk Assessment Report is prepared for the proposed project considering all safety measures.

b) TEAM MEMBERS:

Functional Areas	Name of the Team Member	Involvement (Period &Task)
WP, SHW	Srikumar Malakar	January, 2022 – July, 2022 Assist to Mr. P.K.Goel for: Identification of solid wastes and its mitigation measures. Assist to Mr. Himanshu Gupta for : Identification of impacts on WP and suggesting mitigation measures.
AP	Ravikant Sharma	January, 2022 – July, 2022 Assist to Mr. J.K.Joshi for : Identification of impacts due to air pollution and suggesting mitigation measures.
SHW	Himanshu Gupta	January, 2022 – July, 2022 Assist to Mr. P.K.Goel for : Identification of solid wastes and its mitigation measures.

ANNEXURE- I

APPROVED TERMS OF REFERENCE

No.11-30/2011-IA.III

Goverment of India

Minister of Enviroment,Forest and Climate Change

Impact Assessment Division

***

Indira Paryavaran Bhavan,
Vayu Wing,3rd Floor,Aliganj,
Jor Bagh Road,New Delhi-110003
09 Sep 2021

To,

M/s INDIAN OIL LNG PRIVATE LIMITED
Ennore LNG Terminal, Inside Kamarajar Port,,
Tiruvallur-600120
Tamil Nadu

Tel.No.44-28333755; Email:ceo@indianoillng.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/TN/IND2/226614/2021
2. Name of the Proposal:	ENNORE LNG(Liquified Natural Gas) TERMINAL
3. Category of the Proposal:	Industrial Projects - 2
4. Project/Activity applied for:	6(a) Oil & gas transportation pipe line (crude and refinery/ petrochemical
5. Date of submission for TOR:	02 Sep 2021

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:

6(a): STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR OIL & GAS TRANSPORTATION PIPE LINE (CRUDE AND REFINERY/ PETROCHEMICAL PRODUCTS), PASSING THROUGH NATIONAL PARKS/SANCTUARIES/CORAL REEFS/ECOLOGICALLY SENSITIVE AREAS INCLUDING LNG TERMINAL INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

1. Justification of the project
2. Route map indicating project location.
3. Details of land to be acquired. Details of projects vis-à-vis Ecological Sensitive Areas and approvals thereof.
4. Project location along with map of 1 km area (500 meters on either side of the pipeline from centerline) and site details providing various industries, surface water bodies, forests etc.
5. Analysis of alternative sites and Technology.
6. Location of National Park/Wild life sanctuary/Reserve Forest within 10 km radius of the project.
7. Status of clearance from NBWL for pipeline passing through wildlife sanctuary/ Eco-logical sensitive area.
8. Recommendation of SCZMA /CRZ clearance for the proposed pipeline (if applicable) .
9. Present land use based on satellite imagery for the study area of 10 km radius.
10. Details of applications filed for forest clearance to be obtained for the project for the forest land involved in the project along with details of the compensatory afforestation.
11. Process Description along with Process Flow Diagram.
12. Details of associated facilities/utilities to be installed.
13. Details of water consumption and source of water supply, waste water generation, treatment and effluent disposal.
14. Detailed solid & Hazardous waste generation, collection, segregation, its recycling and reuse, treatment and disposal.
15. Total cost of the project along with total capital cost and recurring cost/annum for environmental pollution control measures.
16. Site-specific micro-meteorological data for temperature, relative humidity, hourly wind speed and direction and rainfall for one season at one location.
17. Ambient air quality monitoring within the study area of 500 m along the pipeline route and around the pumping station and delivery station for PM2.5, PM10, SO2 , NOx, CO, HC, VOC for one

season(Non Monsoon) taking into account the pre-dominant wind direction at the representative locations covering population zone and sensitive receptors including reserved forests.

18. Determination of atmospheric inversion level and assessment of ground level concentration of pollutants. Air quality modelling for proposed project.
19. Water monitoring to be conducted including surface & ground water for one season (Non Monsoon).
20. Soil sample analysis within the study area for one season (Non Monsoon).
21. Noise Monitoring will be taken up for one season (Non Monsoon)
22. Demography & socio-economics of the study area.
23. Ecological features (terristrial& Aquatic) of the study area for one season (Non Monsoon)
24. Assessment of impact on air, water, soil, solid/hazardous waste and noise levels.
25. A detailed note on method to be used for crossing road, nalla, stream, rivers, railway line etc.
26. Air pollution control measures proposed for the effective control of gaseous emissions within permissible limits.
27. Details of proposed preventive measures for leakages and accident.
28. Risk assessment including Hazard identification, Consequence Analysis, Risk Assessment and preparation of Disaster Management Plan as per Regulations.
29. Corrosion Management of Pipeline
30. Details of proper restoration of land after laying the pipelines.
31. Details of proposed Occupational Health Surveillance program for the employees and other labour
32. Detailed Environment management Plan (EMP) with specific reference to Energy conservation and natural resource conservation, details of air pollution control system, water & wastewater management, monitoring frequency, responsibility and time bound implementation plan for mitigation measure will be provided.

***

ANNEXURE- II

CERTIFIED COPY OF THE LATEST MONITORING REPORT FROM REGIONAL OFFICE, MOEFCC (CHENNAI)

सत्यमेव जयते

भारत सरकार
GOVERNMENT OF INDIA
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE
Integrated Regional Office, Chennai,
1st floor, Additional Office Block for GPOA, Shastri Bhawan, Haddows Road,
Nungambakkam, Chennai – 600006, Tel.No.044-2822 2325, Fax 28252536
E.Mail: roefccc@gmail.com / roefccc1@gmail.com

F.No. EP/12.1/2018-19/21/TN/ 24 **Dated: 3rd January, 2023**

DHM

To

The Chief General Manager (Projects),
Indian Oil LNG Private Limited
Ennore LNG Terminal,
Inside Kamarajar Port Limited, Ennore, Vallur Post,
Tiruvallur District, Chennai - 600120

Subject: MoEF&CC- Environmental & CRZ Clearance - Setting up of LNG terminal at Ennore, Tamil Nadu by M/s Indian Oil LNG Private Limited - regarding.

Ref: *i.* *EC. No. 11-30/2011-IA-III, dated 10.02.2014*
ii. *EC. No. 11-30/2011-IA.III, dated 22.04.2016*
iii. *EC. No. 11-30/2011-IA.III, dated 10.10.2018*

Sir,

This has reference to your letter No.IOLPL/MOEF&CC/Expansion/2022/1, dated 19.09.2022 requesting for certified compliance report of the above mentioned environmental & CRZ clearances. In this regard, certified copy of compliance report of EC & CRZ clearances dated 10.02.2017 &10.10.2018 is enclosed for your kind reference.

This has the approval of the Competent Authority vide diary No.914 dated 02.01.2023

Yours faithfully,

Psaranya

(Dr. Saranya. P)
Scientist 'D'
Email: saranya.p@gov.in

Dr. P. Saranya
Scientist 'D'
Government of India
Min. of Environment Forest and Climate Change,
Integrated Regional Office,
1st Floor, Addl. Office Block for GPOA,
Shastri Bhawan, Haddows Road,
Nungambakkam, Chennai - 600 006.

GOVERNMENT OF INDIA
Ministry of Environment, Forest and Climate Change
(Integrated Regional Office, Chennai)

MONITORING REPORT

PART-1

DATASHEET

1	Project Type : River valley/ Mining/ Industry/Thermal/ Nuclear/Other Specify		Industry (others) - LNG Terminal
2	Name of the project		MoEF&CC- Environmental & CRZ Clearance - Setting up of LNG terminal at Ennore, Tamil Nadu by M/s Indian Oil LNG Private Limited
3	Clearance letter(s)/OM No. and dated		EC. No. 11-30/2011-IA-III, dated 10.02.2014 EC. No. 11-30/2011-IA.III, dated 22.04.2016 EC. No. 11-30/2011-IA.III, dated 10.10.2018
4	Locations		
	a	District	Tiruvallur
	b	State/UT	Tamil Nadu
	c	Latitudes	
	d	Longitudes	
5	Address of correspondence		
	a	Address of concerned project Head (with Pin Code & telephone/telex/fax numbers	The Chief General Manager (Projects), Indian Oil LNG Private Limited Ennore LNG Terminal, Inside Kamarajar Port Limited, Ennore, Vallur Post, Tiruvallur District, Chennai - 600120 Email: sureshcalapatti@indianoillng.in
6	Salient features		
	a	of the project	
	b	of the environmental management plans	(i) Green belt development (ii) Monitoring of environmental parameters (AAQ/Noise/Water quality)
7	Breakup of the project area		
	a	Submergence area (forest & non-forests)	Nil No Forest land
	b	Others	

<table>
<tr><td>8</td><td colspan="2">Break up of project affected population with enumeration of those losing houses/dwelling units only, agricultural land only, both dwelling units and agricultural land and landless labourers/artisans</td><td>Nil</td></tr>
<tr><td></td><td>a</td><td>SC,ST/Adivasis</td><td>No displacement of population</td></tr>
<tr><td></td><td>b</td><td>Others</td><td>Not applicable</td></tr>
<tr><td>9</td><td colspan="2">Financial Details</td><td></td></tr>
<tr><td></td><td>a</td><td>Project cost as originally planned and subsequent revised estimates and the years of price reference</td><td>Rs. 3835 Crores as informed by PA</td></tr>
<tr><td></td><td>b</td><td>Allocations made for environmental management plans, with item wise and year wise breakup</td><td><table><tr><th>S.No</th><th>Year</th><th>Approximate amount spent in Rs.</th></tr><tr><td>1</td><td>2019-20</td><td>69,00,000</td></tr><tr><td>2</td><td>2020-21</td><td>68,00,000</td></tr><tr><td>3</td><td>2021-22</td><td>74,00,000</td></tr><tr><td>4</td><td>2022-23</td><td>35,00,00,000</td></tr></table></td></tr>
<tr><td></td><td>c</td><td>Benefit cost ratio/internal rate of return and the years of assessment</td><td>---</td></tr>
<tr><td></td><td>d</td><td>Whether (c) includes the cost of environmental management as shown in (b) above</td><td>-</td></tr>
<tr><td></td><td>e</td><td>Total expenditure on the Project so far</td><td>Rs.3835 crores</td></tr>
<tr><td></td><td>f</td><td>Actual expenditure incurred on the environmental management plans so far</td><td><table><tr><th>S.No</th><th>Year</th><th>Approximate amount spent in Rs.</th></tr><tr><td>1</td><td>2019-20</td><td>69,00,000</td></tr><tr><td>2</td><td>2020-21</td><td>68,00,000</td></tr><tr><td>3</td><td>2021-22</td><td>74,00,000</td></tr><tr><td>4</td><td>2022-23</td><td>35,00,00,000</td></tr></table></td></tr>
<tr><td>10</td><td colspan="2">Forest land requirement</td><td></td></tr>
<tr><td></td><td>a</td><td>The status of approval for a diversion of forest land for non-forestry use</td><td>No forest land involved</td></tr>
<tr><td></td><td>b</td><td>The status of compensatory afforestation, if any</td><td>Not applicable</td></tr>
<tr><td></td><td>c</td><td>The status of clear felling</td><td>Not applicable</td></tr>
<tr><td></td><td>d</td><td>Comments on the viability and sustainability of compensatory afforestation programme in the light of actual field experience so</td><td>Not applicable</td></tr>
</table>

		far	
11	The status of clear felling in non-forest area (such as submergence area of reservoir, approach road), if any, with quantitative information		Not applicable
12	Status of construction		
	a	Date of commencement	November, 2016
	b	Date of completion (actual and/or planned)	March, 2019
13	Reasons for the delay if the project is yet to start.		-
14	Date of site visit		
	a	The dates on which the project was monitored by the Regional Office on previous occasions, if any	Nil
	b	Date of site visit for this monitoring report	31.10.2022

This has the approval of the Competent Authority vide Diary No. 914 dated 02.01.2023.

(Dr. Saranya P)
Scientist D
Email: saranya.p@gov.in

Dr. P. Saranya
Scientist 'D'
Government of India
Min. of Environment Forest and Climate Change,
Integrated Regional Office,
1st Floor, Addl. Office Block for GPOA,
Shastri Bhawan, Haddows Road,
Nungambakkam, Chennai - 600 006.

Dr. P. Saranya
Scientist 'D'
Government of India
Min. of Environment Forest and Climate Change,
Integrated Regional Office,
1st Floor, Addl. Office Block for GPOA,
Shastri Bhawan, Haddows Road,
Nungambakkam, Chennai - 600 006.

CERTIFIED COPY OF THE COMPLIANCE REPORT

Subject: **Environmental and CRZ Clearance for setting up of LNG terminal at Ennore, Tamil Nadu by M/s. Indian Oil LNG Private Limited - reg.**

Reference: EC. No. 11-30/2011-IA-III, dated 10.02.2014
EC. No. 11-30/2011-IA.III, dated 22.04.2016
EC. No. 11-30/2011-IA.III, dated 10.10.2018

Present status of the Project:

The unit was accorded environmental & CRZ clearance vide Ministry's letter dated 10.02.2014 in favour of M/s Indian Oil Corporation Limited. Later vide Ministry's letter dated 22.04.2016, the EC under reference was transferred from M/s Indian Oil Corporation Limited to M/s Indian Oil LNG Private Limited. Further, the environmental & CRZ clearance was amended in respect of CER activities vide Ministry's letter dated 10.10.2018. The unit is operational with LNG storage tanks capacity of 2*180000 cu.m (5 MMTPA) and regasification facilities for converting LNG to gas. The LNG is received through ships and unloaded in storage tanks using a pipeline of length 2.5 km from Jetty. The unit also consists of Captive power plant (2*9.425 MW operating and 1*9.425 MW as standby).

M/s Indian Oil LNG Private Limited had obtained Consent for Establishment (CFE) for the unit from TNPCB under Air (Prevention and control of pollution) Act, 1981 and Water (Prevention and control of pollution) Act, 1974, vide proceedings No.T12/TNPCB/F.0770AMB/RL/AMB/A/2016, and T12/TNPCB/F.0770AMB/RL/AMB/W/2016, dated 16.04.2022 respectively.

The PA had obtained latest CTO from TNPCB under Air (Prevention and control of pollution) Act, 1981 and Water (Prevention and control of pollution) Act, 1974, vide proceedings No. T2/TNPCB/F.0448GMP/RL/GMP/A/2022, and T2/TNPCB/F.0448GMP/RL/GMP/W/2022, dated 16.04.2022 valid till 31.03.2025. The PA had obtained authorization under Rule 6(2) of the Hazardous and other Wastes (Management and Transboundary Movement) Rules, 2016 vide

proceedings No.T2/TNPCB/F.0448GMP/HWA/RL/GMP/2019, dated 24.09.2019 valid upto 31.03.2024.

The PA had now applied for expansion of their existing terminal in Ennore from 5 MMTPA to 10 MMTPA within the existing area of 128 acres. Therefore, the PA has requested Integrated Regional Office of MoEF&CC, Chennai to provide Certified Copy of the Compliance Report.

The above project was monitored by the undersigned on 31.10.2022 along with project authorities. The report is submitted on the basis of the field visit and as per the information provided by the PP. The status of compliance on the stipulated conditions contained in the EC cited above is given below.

Date of Monitoring: 31.10.2022

PART-III

S.No	Conditions	Compliance Status
Part - A.	**Specific Conditions:**	
(i)	Precautionary measures shall be put in place to prevent leakage of LNG due to any disasters including tidal/ tsunami wave, seismic and other natural calamities. Disaster Management Plan shall put in place to manage emergencies.	**Complied.** Precautionary measures are put in place to prevent leakage of Liquefied Natural Gas (LNG) and PNGRB approved Disaster Management Plan is prepared and in place to manage emergencies. Also, Bureau Veritas India Private Limited certified the Emergency Response and Disaster Management Plan (ERDMP) (Doc No. IOLPL/HSEF/SOP/ERDMP/02/Rev.02), having validity till 10.05.2026. The certificate of conformity is enclosed at ***Annexure-I.***
(ii)	Oil Spill Contingency Management Plan shall be put in place.	**Refer below** M/s Indian Oil LNG Pvt. Ltd (IOLPL) is located inside Kamarajar Port Limited (KPL), Ennore.

		The PA informed that their jetty is receiving ships that are operated using LNG. As per the agreement between IOLPL and KPL major oil spill containment will be done in co-ordination with KPL, as informed by PA. In case of any minor spills IOLPL is having facility to handle the situation.
(iii)	Mooring hooks shall be provided with online sensor for load monitoring as committed.	**Complied.** All the mooring hooks are provided with Load sensors for auto tensioning.
(iv)	No R & R is involved and no livelihood is affected since the facilities are within the existing Port.	**Complied** The entire unit is located inside Kamarajar Port Limited (KPL), Ennore. Hence there is no R&R involved and no livelihood is affected.
(v)	Project proponent shall explore training the local population with the help of training institutes like ITI etc., to make them suitable for employment in the facility.	**Refer below** The PA informed that the local population has been identified, trained in IOLPL and are put on contract roles.
(vi)	All the conditions stipulated by the Tamil Nadu Coastal Zone Management Authority (TNCZMA) vide letter No. 5132/EC.3/2013-1, dated 20.09.2013, shall be complied with.	
	• The safety regulations and other guidelines prescribed by the Oil Industry Safety Directorate in the Ministry of Petroleum and Natural Gas, Petroleum Explosives safety Organization (PESO) shall be strictly implemented.	**Complied** The PA has obtained PESO license for storage of compressed gas in pressure vessels vide letter No. S/HO/TN/03/1258(S93113), dated 18.02.2019, valid till 30.09.2024. The copy is enclosed at ***Annexure-2.***
	• The designing and construction of LNG Terminal shall comply with the National and International standards.	**Refer below** The PA informed that the designing and construction of LNG Terminal is as per the National and International standards.
	• Adequate care should be taken to maintain the safety of sea walls,	**Refer below**

	which were already erected adjacent to the project site, so as to prevent any adverse impact on the proposed storage tanks at the project site due to erosion or any other natural calamities.	During the visit, it was observed that unit is situated inside Kamarajar Port Limited, Ennore. As per the CRZ map, it is observed that more than 200 meters exists between shore line and plant boundary and LNG storage tanks are situated at further distance of 60 meters from plant boundary.
	• Even though the dredging near the LNG jetty inside the port area will be carried out by the Ennore port, the safe disposal of dredged material shall be ensured.	**Refer below** The entire unit is located inside Kamarajar Port Limited (KPL), Ennore. The PA informed that regular dredging is being carried out by KPL; however, it is being ensured that the dredged material is disposed off safely.
	• A detailed Risk analysis with reference to the gas leak shall be prepared and based on the probable consequences; a Risk Management Plan shall be evolved for implementation during operational phase. Main focus should be given on the safety of personnel on the event of any disaster or accidents.	**Refer below** The PA informed that Risk analysis with reference to gas leak based on probable consequence has been carried out and incorporated in Environment Impact Assessment & Quantitative Risk Analysis.
	• The EIA report furnished by the unit is having only indicative water quality monitoring parameters. Comprehensive Marine Water Quality monitoring shall be conducted periodically with reference to the parameters viz, physical, chemical, heavy metals, biological, bacteriological, fish eggs and larvae.	**Refer below** The PA informed that they are not discharging any effluent into marine sea water. However Ambient Air Quality Monitoring, Noise Monitoring & Marine water analysis is being carried out every quarter. Last monitoring was done on 07.07.2022 and is enclosed as ***Annexure 3.***
	• LNG pumps along with motors will be used for pumping operations, the level of noise during pumping operations along with the level of noise generated	**Complied** Monitoring of ambient Noise level is being carried out through NABL recognized third party laboratory *viz.* M/s Hubert Enviro Care

	within the plant due to other operations shall be studied and adequate measures shall be implemented for noise reduction with periodical monitoring mechanism.	Systems (P) Limited. The monitored data, as per report, shows that the values are within the limits. Last monitoring was done on 07.07.2022 and is enclosed as ***Annexure 3.*** TNPCB vide letter No.50/NLS/2021-22, dated 20.01.2022 has furnished report of analysis of Ambient Noise level within the unit and monitored data shows that the values are within the limits.
	• All activities should conform to the provisions of CRZ Notification 2011.	**Agreed to comply** It was submitted that this condition is noted and assured to abide by this conditions
(vii)	Mock drill shall be conducted in collaboration with State Disaster Management Authority or National Disaster Management Authority.	**Complied.** Mock drills are conducted at Regular Intervals. Periodic onsite mock drills are being carried out in presence of Joint Director, Directorate of Industrial Safety and Health. The latest mock drill conducted on 27.08.2022 and its report is enclosed at ***Annexure-4.***
(viii)	Tie-up with specialized hospitals for handling any disaster situation. Earmarking of identified beds in burns ward be done.	**Complied** M/s IOLPL has signed a contract with M/s Dr. Rela Institute and MS Hospital vide letter No. IOLPL/C&P/WO-009/22-23 dated 20.06.2022 for occupational health services and handling disaster situation of their unit. The PA informed that the contract is renewed annually.
(ix)	Onsite Emergency Management Plan shall be put in place.	**Complied** M/s IOLPL has PNGRB approved Emergency Response and Disaster management plan in place and being

		complied. Also, Bureau Veritas India Private Limited certified the Emergency Response and Disaster Management Plan (ERDMP) (Doc No. IOLPL/HSEF/SOP/ERDMP/02/Rev.02), having validity till 10.05.2026. The certificate of conformity is enclosed at ***Annexure-1.***
(x)	All the issues raised in the public hearing shall be incorporated and complied with strictly.	**Complied.**
(xi)	No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal regulation Zone area.	**Refer below** The PA informed that no construction work other than those permitted in Coastal Regulation Zone Notification was carried out in Coastal regulation Zone area.
(xii)	NOC / Clearance shall be obtained confirming that all the firefighting provisions are as per standards specified by the Chief Controller of Explosives / Petroleum & Explosives Safety Organization (PESO) for the additional storage tanks.	**Complied** NOC from State Fire and Rescue services was obtained vide license No. 773/2022, dated 04.03.2022 valid for one year from the date of issue. The NOC is enclosed at ***Annexure-5.*** Further, the layout for the terminal including the Firefighting systems are as approved by PESO.
(xiii)	Leak detection/ warning system shall be provided at strategic locations. Necessary control measures capable of remote operation to shut down the leakage, if any, should be provided.	**Refer below** The PA informed that leak detection/ warning system is provided at strategic locations. Necessary control measures capable of remote operation to shut down the leakage, is also provided.
(xiv)	The smooth and safe operation of the system will be ensured by incorporating a computerized SCADA (Supervisor Control And Data Acquisition) system. Any leakage in the pipeline shall be	**Complied.** The PA informed that the facility is provided with Flame and Open Path gas detectors which upon activation will shut down as per logic.

	immediately detected by the Computer System and product pumping shall be immediately cut off.	LNG spill detectors are provided in the terminal which will initiate alarm upon activation and signal will be received in DCS panel at MCR & FCR, as informed by PA.
(xv)	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.	**Complied.** Regular patrolling is carried out by Operation, Maintenance and Safety teams, as informed by PA.
(xvi)	The project shall be carried out as per international standards in vogue and duly certified by competent authorities before commissioning.	**Reportedly complied**
(xvii)	Oil Spill Contingency Management Plan shall be put in place along with the dedicated staff to deal with Oil spill in and around the port area shall be provided in the port. No oily wastes shall be discharged into the water bodies/ mangrove areas.	**Refer below** The PA informed that no Oil is being loaded/ Unloaded in the terminal and no bunkering is permitted at IOLPL jetty. The PA further informed that LNG carriers are fucled by LNG, so there is minimal probability of Oil leakage and spill for which IOLPL is having facility to contain the oil spill.
(xviii)	The project proponent shall set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive.	**Complied** M/s IOLPL has Health, Safety and Environment (HSE) division as per their corporate policy, which looks after the environmental aspects of the plant too. Also, all the environmental parameters are being monitored by NABL accredited consultant *viz.* M/s Hubert Enviro Care Systems (P) Ltd.
(xix)	The project proponent shall take up mangrove plantation/ green belt in the project area, wherever possible.	**Complied** The PA informed that around 42 acres of

<table>
<tr><td></td><td>Adequate budget shall be provided in the Environment Management Plan for such mangrove development.</td><td>land is earmarked for green belt development and is being maintained.
<table><tr><th>S.No</th><th>Year</th><th>No. of plantations done</th></tr><tr><td>1</td><td>2018-19</td><td>7600</td></tr><tr><td>2</td><td>2019-20</td><td>4800</td></tr><tr><td>3</td><td>2020-21</td><td>1000</td></tr><tr><td>4</td><td>2021-22</td><td>200</td></tr></table>
The entire unit is located inside Kamarajar Port Limited (KPL), Ennore. There is no mangrove area within the unit and the PA informed that as advised by local DFO, the greenbelt development has been taken place.</td></tr>
<tr><td>(xx)</td><td>The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.</td><td>Complied.

The funds utilized for environment management plan, as provided by PA is under:
<table><tr><th>S.No</th><th>Year</th><th>Approximate amount spent in Rs.</th></tr><tr><td>1</td><td>2019-20</td><td>69,00,000</td></tr><tr><td>2</td><td>2020-21</td><td>68,00,000</td></tr><tr><td>3</td><td>2021-22</td><td>74,00,000</td></tr><tr><td>4</td><td>2022-23</td><td>35,00,00,000</td></tr></table>
The PA assured EMP funds are not being diverted for any other purposes.</td></tr>
<tr><td>B.</td><td>General Conditions:-</td><td></td></tr>
<tr><td>(i)</td><td>Adequate provision for infrastructure facilities including water supply fuel and sanitation must be ensured for construction phase of the project to avoid any damage to the environment.</td><td>Refer below

The PA informed that during construction phase adequate provision for infrastructure facilities including water supply fuel and sanitation was ensured</td></tr>
<tr><td>(ii)</td><td>Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.</td><td>Agreed to comply

It was submitted that this condition is noted and assured to abide by this conditions</td></tr>
<tr><td>(iii)</td><td>Full support shall be extended to the officers of this Ministry / Regional</td><td>Complied</td></tr>
</table>

	Office at Bangalore by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.	The PA extended their full cooperation during the visit.
(iv)	Ministry of Environment & Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	**Agreed to comply** It was submitted that this condition is noted and assured to abide by this conditions
(v)	This Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with to the satisfaction of this Ministry.	**Agreed to comply** It was submitted that this condition is noted and assured to abide by this conditions
(vi)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment and Forests.	**Complied** Original approval was obtained in the name of M/s Indian Oil Corporation Limited subsequently transferred into M/s Indian Oil LNG Private Limited vide Ministry's letter dated 22.04.2016.
(vii)	The Project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	**Complied** The final approval of the project by the concerned authorities and the date of start of land development work were submitted to the Regional office of the Ministry as part of six monthly compliance reports.
(viii)	A copy of the clearance letter shall be marked to concerned Panchayat/local NGO, if any, from whom any suggestion / representation has been made received while processing the proposal.	**Complied.** The PA informed that they did not receive any suggestions/representations on the project during appraisal process and hence, the copy of clearance letter was not submitted to concern.

		The copy of clearance letter is available on the website of the company https://www.indianoillng.com/statutory-compliance/
(ix)	Tamil Nadu Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's Office / Tehsildar's office for 30 days.	**Reportedly complied**
8.	These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter.	**Complied** M/s Indian Oil LNG Private Limited had obtained Consent for Establishment (CFE) for the unit from TNPCB under Air (Prevention and control of pollution) Act, 1981 and Water (Prevention and control of pollution) Act, 1974, vide proceedings No.T12/TNPCB/F.0770AMB/RL/AMB/A/2016, and T12/TNPCB/F.0770AMB/RL/AMB/W/2016, dated 16.04.2022 respectively. The PA had obtained latest CTO from TNPCB under Air (Prevention and control of pollution) Act, 1981 and Water (Prevention and control of pollution) Act, 1974, vide proceedings No. T2/TNPCB/F.0448GMP/RL/GMP/A/2022, and T2/TNPCB/F.0448GMP/RL/GMP/W/2022, dated 16.04.2022 valid till 31.03.2025. The PA has obtained PESO license for storage of compressed gas in pressure vessels vide letter No. S/HO/TN/03/1258(S93113), dated 18.02.2019, valid till 30.09.2024
9.	All other statutory clearances such as the approvals for storage of diesel	**Complied**

	from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	The PA has obtained PESO license for storage of compressed gas in pressure vessels vide letter No. S/HO/TN/03/1258(S93113), dated 18.02.2019, valid till 30.09.2024. The PA has obtained PESO license for storage of diesel 40 KL vide letter No. P/HQ//TN/15/5209(P397880), dated 11.11.2020 valid till 31.12.2023.
10.	The project proponent shall advertise at least in two local newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded environmental and CRZ Clearance and copies of clearance letters are available with the Tamil Nadu State Pollution Control Board and may also be seen at website of the Ministry of Environment and Forests at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional Office of this Ministry at Bangalore.	**Complied** The PA had advertised in English (The Hindu) newspaper and Tamil newspaper (The Daily Thanthi) on 20.02.2014. The copy of the same is enclosed at ***Annexure-6*** The advertisement has been made within7 days from the date of receipt of the clearance letter. The copy of advertisement published was submitted to the Regional office of the Ministry as part of six monthly compliance report.
12.	Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under section 16 of the National Green Tribunal Act, 2010.	**Complied** The PA informed that there is no appeal lying with National Green Tribunal (NGT) against this Environmental & CRZ clearance as on date
13.	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad / Municipal Corporation, Urban Local Body and the Local NGO, if any, from whom	**Complied.** The PA informed that they did not receive any suggestions/representations on the project during appraisal process and hence,

	suggestions / representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by the proponent.	the copy of clearance letter was not submitted to concern. The copy of clearance letter is available on the website of the company https://www.indianoillng.com/statutory-compliance/
14.	The proponent shall upload the status of compliance of the stipulated Clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	**Complied** The PA regularly submits the six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to this office and TNPCB. The PA was also directed to submit copy of the same to regional office of CPCB. The compliance statements are also uploaded in their official website. https://www.indianoillng.com/statutory-compliance/
15.	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	**Complied.** The PA regularly submits the six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to this office and TNPCB. The PA was also directed to submit copy of the same to regional office of CPCB.
16.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules,	**Complied** The PA has submitted Environment Statement (Form-V) for the period 2020-2021 to TNPCB vide letter reference no: IOLPL/Form-V/TNPCB/GPD/2021/01 dated 25.09.2021.

	1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of Clearance conditions and shall also be sent to the respective Regional Office of MoEF by e-mail.	The copy of the same is available in their website https://www.indianoillng.com/statutory-compliance/

Amendment of Environmental & CRZ clearance dated 10.10.2018

<table>
<tr><th>S.No.</th><th>Additional conditions</th><th>Compliance Status</th></tr>
<tr><td>4.</td><td>As per Ministry's Office memorandum F.No. 22-65/2017-IA.III dated 1st May, 2018, the project proponent is required to prepare and implement Corporate Environment Responsibility (CER). As per para 6(II) of the said OM appropriate funds shall be earmarked for the activities such as infrastructure creation for drinking water supply, sanitation, health, education, skill development, roads, cross drains, electrification including solar power, solid waste management facilities, scientific support and awareness to local farmers to increase yield of crop and fodder, rain water harvesting, soil moisture conservation works, avenue plantation, plantation in community areas etc. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance report, and to the District Collector. It should be posted on the website of the project proponent.</td><td>Agreed to comply

As per Ministry's office memorandum F.No. 22-65/2017-IA.III dated 1st May, 2018, the CER is 0.5% of the total project cost i.e. 19.17 crores.
<table>
<tr><th>S.No.</th><th>Name of the activity</th><th>Year</th><th>Amount spent (in Rs.)</th></tr>
<tr><td>1</td><td>Public address system to Govt. School</td><td>2018-19</td><td>21,000</td></tr>
<tr><td>2</td><td>Eye camp at Athipattu</td><td>2018-19</td><td>1, 50,000</td></tr>
<tr><td>3</td><td>Supply of school desk bench to Government School, Kattupalli</td><td>2018-19</td><td>2,60,000</td></tr>
<tr><td>4</td><td>Supply of Essential commoditie s to nearby local villages</td><td>2020-21</td><td>9,00,000</td></tr>
<tr><td>5</td><td>Contributio n of 10 lakhs to covid relief fund to</td><td>2021-22</td><td>10,00,00 0</td></tr>
</table></td></tr>
</table>

				Tiruvallur district	
					23,31,000

The PA informed that the balance amount to be spent towards CER, will be undertaken in consultation with District Collectorate Office, Tiruvallur.

This has the approval of the Competent Authority vide Diary No. 914 dated 02.01.2023.

(Dr. Saranya P)
Scientist D
Email: saranya.p@gov.in

Dr. P. Saranya
Scientist 'D'
Government of India
Min. of Environment Forest and Cl... ...ange,
Integrated Region...
1st Floor, Addl. Of...
Shastri Bha...
Nu...

Dr. P Saroja
Scientist 'E'
Government of India
Min. of Environment, Forest and ...
Integrated Re...
1st Floor, Addl. ...
Sha...
N...

Environmental and CRZ Clearance for setting up of LNG terminal at Ennore, Tamil Nadu by M/s Indian Oil LNG Private Limited

Fig.1 A view of pipeline from Indian Oil LNG Pvt Limited Jetty to the Storage unit

Fig. 2. A view of green belt development within the unit

Fig.3. Hazardous waste storage area within the unit

Fig.4. Diesel Oil Storage tank

Certificate of Conformity

IndianOil LNG Private Limited

Ennore LNG Terminal

Bureau Veritas India Private Limited certifies that the Emergency Response and Disaster Management Plan (ERDMP) prepared and implemented by IndianOil LNG Private Limited (Doc. No. IOLPL/HSEF/SOP/ERDMP/02/Rev.02) has been reviewed and found to be in accordance with the provisions of the Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP) Regulations, 2010.

Certification start date: 11th May 2021

Subject to the continued satisfactory operation of the organisation's Emergency Response and Disaster Management System, this certificate expires on 10th May 2026.

Head – HSE, Industry

Director - Industry

Certificate No.: 000123 *BV Ref. No.: IND.C.4.20.0619/IOLPL/ENNORE/ERDMP*

Local office:
Bureau Veritas India Private Ltd.
72 Business Park, Marol Industrial Area, Opp. Seepz Gate No. 02, MIDC Cross Road "C" Andheri (East), Mumbai – 400093, India
Tel. +91 22 62742000; Fax +91 22 62742008; Email: industry.mumbai@in.bureauveritas.com
www.bureauveritas.co.in; www.bureauveritas.com

NOTE: This certificate is issued within the contract, scope and conditions stipulated in the enclosed letter no. BVII/IND.C.4.20.0619/HSE/ERDMP dated 11.05.2021

तार "विस्फोट", नागपुर
Telegram: "EXPLOSIVES", Nagpur
Website:http://peso.gov.in
Email:
esplosives@explosives.gov.in
दूरध्वनि/Telephone 0712-2510248
फैक्स/FAX 2510577

All communications intended for this Office should be addressed to the 'Chief Controller of

भारत सरकार
GOVERNMENT OF INDIA
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन
ROLEUM AND EXPLOSIVES SAFETY ORGANISATION
(पूर्व नाम: विस्फोटक विभाग)
(Formerly- Department of Explosives)
"ए" ब्लॉक, 5वीं मंजिल, सीजीओ कॉम्प्लेक्स,
"A" Block, 5th Floor, CGO Complex,
सेमीनरी हिल्स, नागपुर-440 006 (महा.)
Seminary Hills, Nagpur- 440006

No. G.22(47)168/IOCL/LNG
Nagpur dated 19.02.2019

To,

M/s. Indian Oil L.N.G. Pvt. Ltd.,
Level 8, Indian Oil Bhavan,
139, Nungambakkam High Road, Chennai – 600 034

Sub:- Permission for commissioning of LNG marine & handling facilities for LNG Import and Handling jetty with associated facilities at Ennore Port in Tamilandu under Manufacture, Storage & Import of Hazardous Chemicals (MSIHC) Rules, 1989 – Regarding

Dear Sir,

Please refer to your letter No. IOLPL/PESO/JETTYPIPELINE/2018-14 dated 13.02.2018 & Jt. Chief Controller of Explosives, South Circle, Chennai's inspection report dated 07/02/2019 on the above subject.

It is noted that you have completed entire facilities of installation of LNG marine & handling facilities for LNG Import and Handling jetty with associated facilities at Ennore Port in Tamilandu as per approval accorded vide this office letter of even number dated 26/04/2018 and also provided firefighting facilities as per OISD 156 including satisfactory compliance to the recommendations of precommissioning safety audit, there is no objection in commissioning LNG marine & handling facilities for LNG Import and Handling jetty with associated facilities at Ennore Port in Tamilandu with the ***condition to obtain approval / clearance from Chief Inspector of Dock Safety appointed under the Dock Workers (Safety, Health and Welfare) Act, 1986 as per the MSIHC Rules, 1989.*** .

This permission does not absolve you from obtaining necessary permission/clearances from other authorities or under other statutes as applicable.

A set of drawings are returned herewith duly endorsed in token of approval.

Yours faithfully,

Jamuna Rout

(J. Rout)
Dy. Controller of Explosives
for Chief Controller of Explosives

Copy to the Jt. Chief Controller of Explosives, South Circle, Chennai with reference to his memo number G-22(47)168/IOCL/LNG dated 07/02/2019.

for Chief Controller of Explosives

तार "विस्फोट", नागपुर
Telegram 'EXPLOSIVES', Nagpur
Website http://peso.gov.in
Email
explosives@explosives.gov.in
Telephone : 0712-2510248
FAX : 2510577

All communications intended for this Office should be addressed to the 'Chief Controller of

भारत सरकार
GOVERNMENT OF INDIA
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन
PETROLEUM AND EXPLOSIVES SAFETY ORGANISATION
(Formerly- Department of Explosives)
"A" Block, 5th Floor, CGO Complex,
सेमीनरी हिल्स, नागपुर-440 006 (महा.)
Seminary Hills, Nagpur- 440006

No. P.2(4)1157
Nagpur dated 19.02.2019

To,

M/s. Indian Oil L.N.G. Pvt. Ltd.,
Level 8, Indian Oil Bhavan,
139, Nungambakkam High Road, Chennai – 600 034

Sub:- Permission for commissioning of two LNG pipeline (Cryogenic) 36" dia X 2.5 Kms &.One 8" X 2.5 Km. NG vapour return line from Jetty head to LNG import, storage and re-gasification terminal at Ennore Port in Tamilnadu under Manufacture, Storage & import of Hazardous Chemicals (MSIHC) Rules, 1989

Dear Sir,

Please refer to your letter No. IOLPL/PESO/JETTYPIPELINE/2018-7 dated 14.12.2018.

Since the subject pipeline work has been completed in all respect as per approval accorded vide this office letter of even number dated 31/08/2018 and also hydrotested in accordance with the rule 93 of Petroleum Rules, 2002, there is no objection to your commissioning of the subject pipeline with the following condition that :-

1) You are advised to obtain approval / clearance from Chief Inspector of Dock Safety appointed under the Dock Workers (Safety, Health and Welfare) Act, 1986 as per MSIHC Rules, 1989. A copy of the same shall be submitted to this office.
2) Pipeline Integrity Management plan shall be strictly followed.
3) Every precaution shall be taken to safely operate the pipeline and immediate action taken if any unsafe condition is noticed at any stage of operation and maintenance.

The records of design, fabrication and testing of each section of pipeline, location of welds, material of construction, valves, bends, flanges etc. (with identification marking for each weld and fitting) may please be preserved for records.

Please note that operation of the pipeline shall be done according to SOP's furnished and regular patrolling is undertaken to ensure safe use and operation. Annual Safety Audit Report from an independent agency as required under Rule 10 of MSIHC Rules, 1989 shall be carried out and forwarded every year to this office for record.

FORM LS-1A/प्ररुप - एलएस–1क

(See Rules 50, 51, 54 and 55)/(नियम 50 , 51, 54 और 55 देखें)

Licence to Store Compressed gas in pressure vessel or vessels

दाब पात्र या पात्रों में संपीड़ित गैस भण्डारकरण के लिए अनुज्ञप्ति

अनुज्ञप्ति सं/Licence No. : **S/HO/TN/03/1258(S93113)**

फीस रुपए/Fee Rs. **50000/- per year/प्रति वर्ष**

Licence is hereby granted to INDIAAN OIL LNG PVT LTD, Inside Kamarajar Port, Ponneri Taluk, Thiruvallur ,Chennai,Chennai, District: CHENNAI , State: Tamil Nadu PIN: 600120 valid only for the storage of compressed gas in 2 Number(s) of pressure vessels as indicated below in the licensed premises described below and shown in the plan No.S/HO/TN/03/1258(S93113) dated 30/03/2021 subject to the provisions of the Indian Explosives Act, 1884 (4 of 1884) and the rules made thereunder and to the further conditions of this licence.

श्री INDIAAN OIL LNG PVT LTD, Inside Kamarajar Port, Ponneri Taluk, Thiruvallur ,Chennai,Chennai, District: CHENNAI , State: Tamil Nadu PIN: 600120 को नीचे वर्णित अनुज्ञप्त परिसरों में और रेखांकन संख्या S/HO/TN/03/1258(S93113) dated 30/03/2021 में भारतीय विस्फोटक अधिनियम, 1884 (1884 का 4) और उसके अधीन बनाए गए नियमों तथा इस अनुज्ञप्ति की अन्य शर्तों पर 2 दाब पात्र / पात्रों में संपीड़ित गैस के भण्डारण के लिए अनुज्ञप्ति मंजूर की जाती है।

यह अनुज्ञप्ति 30 सितंबर 2024 तक प्रवृत्त रहेगी।

The Licence shall remain in force till the **30th September2024.**

Vessel No./वेसल नंबर	Name of Gas/ गैस का नाम	State of Gas/ गैस की स्थिति	Water Capacity in cubic meter/ जल क्षमता (घ.मी.)	Max. working Pre.(kg/cm^2)/ अधिकतम वर्किंग प्रेशर	Quantity Granted in kgs(Liquified gas)/किलोग्रॅम में जारी मात्रा (लिक्विफाईड गैसेस)
101-T01	LNG	Liquified	180000.00	0.29	78489000
101-T02	LNG	Liquified	180000.00	0.29	78489000
Total Water capacity			**360000.00**		

February 18, 2019

For Chief Controller of Explosives
HQ, Nagpur
कृते मुख्य विस्फोटक नियंत्रक
नागपुर

1). Amendment dated - 26/07/2021

DESCRIPTION AND LOCATION OF THE LICENSED PREMISES/अनुज्ञप्त परिसर का विवरण और अवस्थिती

The licensed premises, the layout boundaries and other particulars of which are shown in the attached approved plan No. S/HO/TN/03/1258 dated 30/03/2021 are situated at Chennai and consists of 2 Mounded Number(s) vessel(s) for storage of :/अनुज्ञप्त परिसर, प्रदर्शित सीमा और अन्य विवरण जो संलग्न अनुमोदित रेखाचित्र क्र.S/HO/TN/03/1258 दिनांक 30/03/2021 में दर्शाए गए है Chennai पर स्थित है और इसमे 2 Mounded वेसल सम्मिलित है।

a) Flammable/Corrosive/Toxic Gases :/ज्वलनशील / संक्षारक / विषैली गैसों: LNG

b) Non-Toxic Gases :/अविषैली गैसों :

and is situated at PlotNo : KAMARAJAR PORT Village/Town :Chennai Police Station : CHENNAI District : CHENNAI, State: Tamil Nadu , Pin : 60.

/प्लाट सख्या PlotNo : KAMARAJAR PORT गांव या नगर :Chennai पुलीस थाना CHENNAI जिला CHENNAI राज्य

प्ररूप XV
(प्रथम अनुसूची का अनुच्छेद 6 देखिए)
FORM XV
(see Article 6 of the First Schedule)

अधिष्ठापनों में पेट्रोलियम के आयात और भंडारकरण के लिए अनुज्ञप्ति
LICENCE TO IMPORT AND STORE PETROLEUM IN AN INSTALLATION

अनुज्ञप्ति सं. (Licence No.) : **P/HQ/TN/15/5209(P397880)** फीस रूपए (Fee Rs.) **5000**/- per year

M/s. INDIAN OIL LNG PVT LTD, 139 NUNGAMBKKAM HIGH ROAD, CHENNAI, CHENNAI, Chennai, Taluka: Chennai, District: CHENNAI, State: Tamil Nadu, PIN: 600034 को केवल इसमें यथा विनिर्दिष्टु वर्ग और मात्राओं में पेट्रोलियम **40.00 KL** आयात करने के लिए और उसका, नीचे वर्णित और अनुमोदित नक्शा संख्या **P/HQ/TN/15/5209(P397880)** तारीख **11/11/2020** जो कि इससे उपाबद्ध हैं, में दिखाए गए स्थान पर भण्डारकरण के लिए पेट्रोलियम अधिनियम, 1934 के उपबंधों या उसके अधीन बनाए गए नियमों तथा इस अनुज्ञप्ति की अतिरिक्त शर्तों के अधीन रहते हुए, यह अनुज्ञप्ति अनुदत्त की जाती हैं ।

Licence is hereby granted to **M/s. INDIAN OIL LNG PVT LTD, 139 NUNGAMBKKAM HIGH ROAD, CHENNAI, CHENNAI, Chennai, Taluka: Chennai, District: CHENNAI, State: Tamil Nadu, PIN: 600034** valid only for the importation and storage of **40.00 KL** Petroleum of the class and quantities as herein specified and storage thereof in the place described below and shown on the approved plan No **P/HQ/TN/15/5209(P397880)** dated **11/11/2020** attached hereto subject to the provisions of the Petroleum Act, 1934 and the rule made thereunder and to the further conditions of this Licence.

यह अनुज्ञप्ति **31st day of December 2023** तक प्रवृत रहेगी ।
The Licence shall remain in force till the **31st day of December 2023**

पेट्रोलियम का विवरण /Description of Petroleum	अनुज्ञप्त मात्रा (किलोलीटरों में) /Quantity licenced in KL
वर्ग क प्रपुंज पेट्रोलियम /Petroleum Class A in bulk	**NIL**
वर्ग क प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class A, otherwise than in bulk	**NIL**
वर्ग ख प्रपुंज पेट्रोलियम /Petroleum Class B in bulk	**40.00 KL**
वर्ग ख प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class B, otherwise than in bulk	**NIL**
वर्ग ग प्रपुंज पेट्रोलियम /Petroleum Class C in bulk	**NIL**
वर्ग ग प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class C,otherwise than in bulk	**NIL**
कुल क्षमता /Total Capacity	**40.00 KL**

February 13, 2019

For Chief Controller of Explosives
HQ, Nagpur

अनुज्ञप्त परिसरों का विवरण और अवस्थान
DESCRIPTION AND LOCATION OF THE LICENSED PREMISES

अनुज्ञप्त परिसर जिसकी विन्यास सीमाएं अन्य विशिष्टयां संलग्न अनुमोदित नक्शों में दिखाई गई हैं **Survey No: 1/1A, Puzhuthivakkam, Puzhuthivakkam, Thiruvallur, Taluka: Ponneri, District: THIRUVALLUR, State: Tamil Nadu, PIN: 600120** स्थान पर

Hubert Enviro Care Systems (P) Ltd.
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Laboratory Services Division
(Chemical & Biological Testing)
FSSAI Notified Laboratory
ISO 9001, 14001 & 45001 Certified.

TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.
Address of the Client : Ennore

Report No : **HECSL/AA/6/020722**
Report Date : **07/07/2022**

Sample Description : Ambient Air Quality
Sampling Location : Near Main Gate
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 01/07/2022 - 02/07/2022
Analysis Commenced On : 02/07/2022

Completed On : 06/07/2022

S.No.	Parameters	Units	Results Obtained	Test Method	NAAQ Standards : 2009	
1	Sulphur Dioxide	µg/m³	12.21	CPCB guide lines Volume I:2012	80 (24 hours)	50 (Annual)
2	Nitrogen Dioxide	µg/m³	20.99	IS: 5182 (Part - 6):2006	80 (24 hours)	40 (Annual)
3	Particulate Matter Size Less than 10 µm	µg/m³	52.06	IS: 5182 (Part - 23):2006	100 (24 hours)	60 (Annual)
4	Particulate Matter Size Less than 2.5 µm	µg/m³	23.08	IS: 5182 (Part - 24):2019	60 (24 hours)	40 (Annual)
5	Carbon Monoxide	mg/m³	BLQ(LOQ 0.05)	IS : 5182 (Part - 10) 1999	4 (1 hours)	2 (8 hours)
6	Lead	µg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 22): 2004	1 (24 hours)	0.5 (Annual)
7	Ozone	µg/m³	11.76	HECS/AIR/AMBIENT/SOP/007 :2013	180 (1 hours)	100 (8 hours)
8	Ammonia	µg/m³	5.76	HECS/AIR/AMBIENT/SOP/006 :2013	400 (24 hours)	100 (Annual)
9	Benzene	µg/m³	BLQ(LOQ 1)	IS: 5182 (Part - 11):2006	5 (Annual)	5 (Annual)
10	Benzo(a)pyrene	ng/m³	BLQ(LOQ 1)	IS: 5182 (Part - 12): 2004	1 (Annual)	1 (Annual)
11	Arsenic	ng/m³	BLQ(LOQ 2)	HECS/AIR/AMBIENT/009:2013	6 (Annual)	6 (Annual)
12	Nickel	ng/m³	BLQ(LOQ 10)	HECS/AIR/AMBIENT/009:2013	20 (Annual)	20 (Annual)

Note:- BLQ - Below the Limit of Quantification. LOQ- Limit of Quantification, µg/m³- Micrograms per cubic meter, mg/m³- Milligrams per cubic meter, ng/m³- Nanograms per cubic meter.

Remarks: The Tested Parameters as above are within the Limits of NAAQ Standards 2009.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD Chennai 600 032

Authorized Signatory

SIVAPRAKASAM. M
Lab Manager

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ISO 9001, 14001 & 45001 Certified.

TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd
Address of the Client : Ennore

Report No : HECSL/AA/7/020722
Report Date : 07/07/2022

Sample Description : Ambient Air Quality
Sampling Location : Near Canteen
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 01/07/2022 -02/07/2022
Analysis Commenced On : 02/07/2022 Completed On : 06/07/2022

S.No.	Parameters	Units	Results Obtained	Test Method	NAAQ Standards : 2009	
1	Sulphur Dioxide	µg/m³	8.63	CPCB guidelines Volume 1:2012	80 (24 hours)	50 (Annual)
2	Nitrogen Dioxide	µg/m³	22.60	IS: 5182 (Part - 6):2006	80 (24 hours)	40 (Annual)
3	Particulate Matter Size Less than 10 µm	µg/m³	47.22	IS: 5182 (Part - 23):2006	100 (24 hours)	60 (Annual)
4	Particulate Matter Size Less than 2.5 µm	µg/m³	21.96	IS: 5182 (Part - 24):2019	60 (24 hours)	40 (Annual)
5	Carbon Monoxide	mg/m³	BLQ(LOQ 0.05)	IS : 5182 (Part - 10) 1999	4 (1 hours)	2 (8 hours)
6	Lead	µg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 22): 2004	1 (24 hours)	0.5 (Annual)
7	Ozone	µg/m³	11.12	HECS/AIR/AMBIENT/SOP/007 2013	180 (1 hours)	100 (8 hours)
8	Ammonia	µg/m³	5.34	HECS/AIR/AMBIENT/SOP/006 2013	400 (24 hours)	100 (Annual)
9	Benzene	µg/m³	BLQ(LOQ 1)	IS: 5182 (Part - 11):2006	5 (Annual)	5 (Annual)
10	Benzo(a)pyrene	ng/m³	BLQ(LOQ 1)	IS: 5182 (Part - 12): 2004	1 (Annual)	1 (Annual)
11	Arsenic	ng/m³	BLQ(LOQ 2)	HECS/AIR/AMBIENT/009:2013	6 (Annual)	6 (Annual)
12	Nickel	ng/m³	BLQ(LOQ 10)	HECS/AIR/AMBIENT/009:2013	20 (Annual)	20 (Annual)

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, µg/m³- Micrograms per cubic meter, mg/m³- Milligrams per cubic meter, ng/m³- Nanograms per cubic meter.

Remarks: The Tested Parameters as above are within the Limits of NAAQ Standards 2009.

"End of Report"

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/AA/8/020722
Report Date : 07/07/2022

Sample Description : Ambient Air Quality
Sampling Location : Near Utility
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 01/07/2022 - 02/07/2022
Analysis Commenced On : 02/07/2022 Completed On : 06/07/2022

S.No.	Parameters	Units	Results Obtained	Test Method	NAAQ Standards : 2009	
1	Sulphur Dioxide	µg/m³	11.31	CPCB guide lines Volume I:2012	80 (24 hours)	50 (Annual)
2	Nitrogen Dioxide	µg/m³	18.38	IS: 5182 (Part - 6):2006	80 (24 hours)	40 (Annual)
3	Particulate Matter Size Less than 10 µm	µg/m³	48.08	IS: 5182 (Part - 23):2006	100 (24 hours)	60 (Annual)
4	Particulate Matter Size Less than 2.5 µm	µg/m³	16.72	IS: 5182 (Part - 24):2019	60 (24 hours)	40 (Annual)
5	Carbon Monoxide	mg/m³	BLQ(LOQ 0.05)	IS : 5182 (Part - 10) 1999	4 (1 hours)	2 (8 hours)
6	Lead	µg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 22): 2004	1 (24 hours)	0.5 (Annual)
7	Ozone	µg/m³	10.15	HECS/AIR/AMBIENT/SOP/007 :2013	180 (1 hours)	100 (8 hours)
8	Ammonia	µg/m³	5.11	HECS/AIR/AMBIENT/SOP/006 :2013	400 (24 hours)	100 (Annual)
9	Benzene	µg/m³	BLQ(LOQ 1)	IS: 5182 (Part - 11):2006	5 (Annual)	5 (Annual)
10	Benzo(a)pyrene	ng/m³	BLQ(LOQ 1)	IS: 5182 (Part - 12): 2004	1 (Annual)	1 (Annual)
11	Arsenic	ng/m³	BLQ(LOQ 2)	HECS/AIR/AMBIENT/009:2013	6 (Annual)	6 (Annual)
12	Nickel	ng/m³	BLQ(LOQ 10)	HECS/AIR/AMBIENT/009:2013	20 (Annual)	20 (Annual)

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, µg/m³- Micrograms per cubic meter, mg/m³- Milligrams per cubic meter, ng/m³- Nanograms per cubic meter.

Remarks: The Tested Parameters as above are within the Limits of NAAQ Standards 2009.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/AA/9/020722
Report Date : 07/07/2022

Sample Description : Ambient Air Quality
Sampling Location : Near FDAV
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 01/07/2022 -02/07/2022
Analysis Commenced On : 02/07/2022

Completed On :06/07/2022

S.No.	Parameters	Units	Results Obtained	Test Method	NAAQ Standards : 2009	
1	Sulphur Dioxide	µg/m³	10.59	CPCB guide lines Volume 1:2012	80 (24 hours)	50 (Annual)
2	Nitrogen Dioxide	µg/m³	17.96	IS: 5182 (Part - 6):2006	80 (24 hours)	40 (Annual)
3	Particulate Matter Size Less than 10 µm	µg/m³	50.15	IS: 5182 (Part - 23):2006	100 (24 hours)	60 (Annual)
4	Particulate Matter Size Less than 2.5 µm	µg/m³	18.84	IS: 5182 (Part - 24):2019	60 (24 hours)	40 (Annual)
5	Carbon Monoxide	mg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 10) 1999	4 (1 hours)	2 (8 hours)
6	Lead	µg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 22): 2004	1 (24 hours)	0.5 (Annual)
7	Ozone	µg/m³	11.66	HECS/AIR/AMBIENT/SOP/007 :2013	180 (1 hours)	100 (8 hours)
8	Ammonia	µg/m³	6.17	HECS/AIR/AMBIENT/SOP/006 :2013	400 (24 hours)	100 (Annual)
9	Benzene	µg/m³	BLQ(LOQ 1)	IS: 5182 (Part - 11):2006	5 (Annual)	5 (Annual)
10	Benzo(a)pyrene	ng/m³	BLQ(LOQ 1)	IS: 5182 (Part - 12): 2004	1 (Annual)	1 (Annual)
11	Arsenic	ng/m³	BLQ(LOQ 2)	HECS/AIR/AMBIENT/009:2013	6 (Annual)	6 (Annual)
12	Nickel	ng/m³	BLQ(LOQ 10)	HECS/AIR/AMBIENT/009:2013	20 (Annual)	20 (Annual)

Note:- BLQ - Below the Limit of Quantification. LOQ- Limit of Quantification. µg/m³- Micrograms per cubic meter, mg/m³- Milligrams per cubic meter, ng/m³- Nanograms per cubic meter.

Remarks: The Tested Parameters as above are within the Limits of NAAQ Standards 2009.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/AA/10/020722
Report Date : 07/07/2022

Sample Description : Ambient Air Quality
Sampling Location : Near Truck Loading Area
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 01/07/2022 -02/07/2022
Analysis Commenced On : 02/07/2022 Completed On :06/07/2022

S.No.	Parameters	Units	Results Obtained	Test Method	NAAQ Standards : 2009	
1	Sulphur Dioxide	µg/m³	12.44	CPCB guide lines Volume 1:2012	80 (24 hours)	50 (Annual)
2	Nitrogen Dioxide	µg/m³	21.23	IS: 5182 (Part - 6):2006	80 (24 hours)	40 (Annual)
3	Particulate Matter Size Less than 10 µm	µg/m³	52.22	IS: 5182 (Part - 23):2006	100 (24 hours)	60 (Annual)
4	Particulate Matter Size Less than 2.5 µm	µg/m³	24.20	IS: 5182 (Part - 24):2019	60 (24 hours)	40 (Annual)
5	Carbon Monoxide	mg/m³	BLQ(LOQ 0.05)	IS : 5182 (Part - 10) 1999	4 (1 hours)	2 (8 hours)
6	Lead	µg/m³	BLQ(LOQ 0.05)	IS: 5182 (Part - 22): 2004	1 (24 hours)	0.5 (Annual)
7	Ozone	µg/m³	10.92	HECS/AIR/AMBIENT/SOP/007 :2013	180 (1 hours)	100 (8 hours)
8	Ammonia	µg/m³	6.32	HECS/AIR/AMBIENT/SOP/006 :2013	400 (24 hours)	100 (Annual)
9	Benzene	µg/m³	BLQ(LOQ 1)	IS: 5182 (Part - 11):2006	5 (Annual)	5 (Annual)
10	Benzo(a)pyrene	ng/m³	BLQ(LOQ 1)	IS: 5182 (Part - 12): 2004	1 (Annual)	1 (Annual)
11	Arsenic	ng/m³	BLQ(LOQ 2)	HECS/AIR/AMBIENT/009:2013	6 (Annual)	6 (Annual)
12	Nickel	ng/m³	BLQ(LOQ 10)	HECS/AIR/AMBIENT/009:2013	20 (Annual)	20 (Annual)

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, µg/m³- Micrograms per cubic meter, mg/m³- Milligrams per cubic meter, ng/m³- Nanograms per cubic meter.

Remarks: The Tested Parameters as above are within the Limits of NAAQ Standards 2009.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD Chennai 600 032

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TEST REPORT

Name of the Client : M/S Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/ST/17/020722
Report Date : 07/07/2022

Sample Description : Stack Emission
Sample Mark : Fire Pump DG Fl No:16-J
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 02/07/2022 -02/07/2022
Analysis Commenced On : 02/07/2022

Completed On :06/07/2022

S.No.	Parameters	Units	Results	Test Method	CPCB Standards
1	Stack Height	meter	12.5	-	NA
2	Stack Diameter	meter	0.25	-	NA
3	Ambient Temperature	°C	34.0	IS 11255 (Part-3) 2008	NA
4	Temperature	°C	117.0	IS 11255 (Part-3)2008	NA
5	Velocity	m/sec	11.3	IS 11255 (Part-3) 2008	NA
6	Sulphur Dioxide	mg/Nm³	14.05	IS 11255 (Part-2) 1985	NA
7	Oxides of Nitrogen	mg/Nm³	28.09	IS 11255 (Part-7) 2005	NA
8	Carbon monoxide	%V/V	BLQ(LOQ 0.2)	IS 13270 - 1992	1% Max
9	Suspended Particulate Matter	mg/Nm³	50.61	IS 11255 (Part-1) 1985	CNTE150
10	Volume of gas discharge	Nm³/hr	1386	IS 11255 (P-3) 2008	NA

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, Nm³/hr - Normal cubic meter per hour, CNTE- Concentration not to Exceed, mg/Nm³- Milligrams per Normal cubic meter, %V/V - Percentage, °C- Degree Celsius, NA - Not Applicable.

Remarks: The Tested Parameters as above are within the Limits of CPCB Stack Emission Standards.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/ST/18/020722
Report Date : 07/07/2022

Sample Description : Stack Emission
Sample Mark : Fire Pump DG Fl No:16-H
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 02/07/2022 -02/07/2022
Analysis Commenced On : 02/07/2022

Completed On :06/07/2022

S.No.	Parameters	Units	Results	Test Method	CPCB Standards
1	Stack Height	meter	12.5	-	NA
2	Stack Diameter	meter	0.25	-	NA
3	Ambient Temperature	°C	34.0	IS 11255 (Part-3) 2008	NA
4	Temperature	°C	109.0	IS 11255 (Part-3)2008	NA
5	Velocity	m/sec	8.9	IS 11255 (Part-3) 2008	NA
6	Sulphur Dioxide	mg/Nm³	9.45	IS 11255 (Part-2) 1985	NA
7	Oxides of Nitrogen	mg/Nm³	24.34	IS 11255 (Part-7) 2005	NA
8	Carbon monoxide	%V/V	BLQ(LOQ 0.2)	IS 13270 - 1992	1% Max
9	Suspended Particulate Matter	mg/Nm³	45.44	IS 11255 (Part-1) 1985	CNTE150
10	Volume of gas discharge	Nm³/hr	1114	IS 11255 (P-3) 2008	NA

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, Nm³/hr - Normal cubic meter per hour, CNTE- Concentration not to Exceed, mg/Nm³- Milligrams per Normal cubic meter, %V/V - Percentage, °C- Degree Celsius, NA - Not Applicable.

Remarks: The Tested Parameters as above are within the Limits of CPCB Stack Emission Standards.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/ST/19/020722
Report Date : 07/07/2022

Sample Description : DG Stack Emission
Sample Mark : DG 1010 KVA
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 02/07/2022 -02/07/2022
Analysis Commenced On : 02/07/2022

Completed On :06/07/2022

S.No.	Parameters	Units	Results	Test Method	CPCB Standards
1	Stack Height	meter	30.0	-	NA
2	Stack Diameter	meter	0.35	-	NA
3	Ambient Temperature	°C	34.0	IS 11255 (Part-3) 2008	NA
4	Temperature	°C	214.0	IS 11255 (Part-3)2008	NA
5	Velocity	m/sec	11.9	IS 11255 (Part-3) 2008	NA
6	Sulphur Dioxide	mg/Nm³	13.60	IS 11255 (Part-2) 1985	NA
7	Oxides of Nitrogen	ppmv	234.07	IS 11255 (Part-7) 2005	710
8	Carbon monoxide	mg/Nm³	BLQ(LOQ 1)	IS 13270 - 1992	150
9	Suspended Particulate Matter	mg/Nm³	47.74	IS 11255 (Part-1) 1985	75
10	Volume of gas discharge	Nm³/hr	2291.0	IS 11255 (P-3) 2008	NA

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, mg/Nm³- Milligrams per Normal cubic meter. ppmv- Parts per million by Volume, m/s- Meter per second, Nm³/hr - Normal cubic meter per hour, NA - Not Applicable.
Remarks :-Standards are given as per CPCB PCLS / 02/ 2010 Sixth Edition (Engine Rating more than 0.8 M W (800 KW);
The Tested Parameters are found within acceptable Limit.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD * Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/ST/20/020722
Report Date : 07/07/2022

Sample Description : DG Stack Emission
Sample Mark : DG 750 KVA
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 02/07/2022 - 02/07/2022
Analysis Commenced On : 02/07/2022 Completed On : 06/07/2022

S.No.	Parameters	Units	Results	Test Method	CPCB Standards
1	Stack Height	meter	12.0	-	NA
2	Stack Diameter	meter	0.35	-	NA
3	Ambient Temperature	° C	34.0	IS 11255 (Part-3) 2008	NA
4	Temperature	° C	192.0	IS 11255 (Part-3)2008	NA
5	Velocity	m/sec	10.2	IS 11255 (Part-3) 2008	NA
6	Sulphur Dioxide	g/Kw-hr	0.034	IS 11255 (Part-2) 1985	NA
7	Oxides of Nitrogen	g/Kw-hr	0.648	IS 11255 (Part-7) 2005	≤4.0(NOx+HC)
8	Carbon monoxide	g/Kw-hr	BLQ(LOQ 0.005)	IS 13270 - 1992	≤3.5
9	Particulate Matter	g/Kw-hr	0.159	IS 11255 (Part-1) 1985	≤0.2
10	Volume of gas discharge	Nm³/hr	2056	IS 11255 (P-3) 2008	NA

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, g/kW-hr- Gram per Kilowatt Hour, %- Percentage, m/s- Meter per second, Nm³/hr - Normal cubic meter per hour, NA - Not Applicable.
Remarks :-Standards are given as per CPCB notification no. G.S.R.771 (E) dated 11th December, 2013 (Engine Rating less than 0.8 M W (800 KW); The Tested Parameters are found in acceptable Limit.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD Chennai 600 032

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/WT/008/020722
Report Date : 06/07/2022

Sample Description : WATER
Sample Mark : Marine Water-Depth
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 30/06/2022 -02/07/2022
Analysis Commenced On : 02/07/2022 Completed On : 05/07/2022

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	8.14	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	47500.0	IS 3025 (Part - 14):1983
3	Turbidity	NTU	1.3	IS 3025(Part - 10):1984
4	Total Dissolved Solids	mg/l	30402.0	IS 3025(Part -16):1984
5	Sulphate as SO4	mg/l	1994.8	IS 3025(Part - 24):1986
6	Nitrate as NO3	mg/l	2.12	IS 3025 (Part 34) 1988
7	Copper as Cu	mg/l	BLQ(LOQ 0.01)	USEPA Method 200.8:1994
8	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	USEPA Method 200.8:1994
9	Lead as Pb	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8:1994
10	Arsenic as As	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8.1994
11	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	USEPA Method 200.8:1994
12	Total suspended solid	mg/l	3.0	IS 3025 (Part - 17):1984
13	BOD,3 days @27°C as O2	mg/l	5.0	IS 3025 (Part - 44):1993
14	Temperature #	°C	28.7	IS 3025 (Part - 9):1984
15	Dissolved oxygen	mg/l	6.2	IS 3025 (Part - 38):1989
16	Ammonia as NH3	mg/l	BLQ(LOQ:0.02)	IS 3025 (Part - 34):1982
17	Nitrite as NO2	mg/l	BLQ(LOQ:0.01)	IS.3025(Part - 34):1988
18	Salinity	ppt	34.14	2520 A APHA 23rd Edn 2017
19	Total Nitrogen as N	mg/l	2.18	IS 3025(Part- 34):1988
20	Dissolved Iron	mg/l	0.043	IS 3025 (Pt 53)-2003
21	Chlorophyll	mg/l	1.82	10200-H APHA 23rd Edn. 2017
22	Inorganic Phosphate		BLQ(LOQ:0.02)	IS : 3025 (Part 31) - 1988
23	Polyneuclear Aromatic Hydrocarbons	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2 : 1995
24	COD as O2	mg/l	60.0	IS 3025 (Part 58) :2006
25	Total Phosphate	mg/l	BLQ(LOQ:0.02)	IS : 3025 (Part 31) - 1988

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, mg/l - Milligrams per liter.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

Authorized Signatory

SIVAPRAKASAM. M
Lab Manager

Hubert Enviro Care Systems (P) Ltd.
A-21, III.Phase, Thiru Vi Ka Industrial Estate,
Guindy, Chennai - 600 032.
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E-mail : labsales@hecs.in

Laboratory Services Division
(Chemical & Biological Testing)
FSSAI Notified Laboratory
ISO 9001, 14001 & 45001 Certified.

TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/MB/014/040722
Report Date : 07/07/2022

Sample Description : WATER
Sample Mark : Marine Water-Depth
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 30/06/2022 -02/07/2022
Analysis Commenced On : 02/07/2022

Completed On : 07/07/2022

S.No.	Parameters	Units	Results	Test Method
1	Faecal coliform	MPN/100ml	<2	IS 1622
2	Fish Eggs	per 100ml	Present	In house validated method
3	larvae	per 100ml	Present	In house validated method

Note:- MPN - Most Probable Number, <2 is Considered as Absent.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD Chennai 600 032

Authorized Signatory
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ISO 9001, 14001 & 45001 Certified.

TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/WT/007/020722
Report Date : 06/07/2022

Sample Description : WATER
Sample Mark : Marine Water Surface
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 30/06/2022 -02/07/2022
Analysis Commenced On : 02/07/2022 Completed On : 05/07/2022

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	8.12	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	47300.0	IS 3025 (Part - 14):1983
3	Turbidity	NTU	2.4	IS 3025(Part - 10):1984
4	Total Dissolved Solids	mg/l	30275.0	IS 3025(Part -16):1984
5	Sulphate as SO4	mg/l	1807.6	IS 3025(Part - 24):1986
6	Nitrate as NO3	mg/l	2.19	IS 3025 (Part 34): 1988
7	Copper as Cu	mg/l	BLQ(LOQ 0.01)	USEPA Method 200.8 1994
8	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	USEPA Method 200.8:1994
9	Lead as Pb	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8:1994
10	Arsenic as As	mg/l	BLQ(LOQ 0.005)	USEPA Method 200.8:1994
11	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	USEPA Method 200.8:1994
12	Total suspended solid	mg/l	5.0	IS 3025 (Part - 17):1984
13	BOD,3 days @27°C as O2	mg/l	4.0	IS 3025 (Part - 44):1993
14	Temperature #	°C	28.9	IS 3025 (Part - 9):1984
15	Dissolved oxygen	mg/l	6.5	IS 3025 (Part - 38):1989
16	Ammonia as NH3	mg/l	BLQ(LOQ:0.02)	IS 3025 (Part - 34) 1982
17	Nitrite as NO2	mg/l	BLQ(LOQ:0.01)	IS:3025(Part - 34):1988
18	Salinity	ppt	33.78	2520 A APHA 23rd Edn. 2017
19	Total Nitrogen as N	mg/l	2.26	IS 3025(Part- 34):1988
20	Dissolved Iron	mg/l	0.062	IS 3025 (Pt 53)-2003
21	Chlorophyll	mg/l	1.85	10200-H APHA 23rd Edn. 2017
22	Inorganic Phosphate	mg/l	BLQ(LOQ:0.02)	IS : 3025 (Part 31) - 1988
23	Polyneuclear Aromatic Hydrocarbons	mg/l	BLQ(LOQ 0.00001)	USEPA Method 525.2 : 1995
24	COD as O2	mg/l	52.0	IS 3025 (Part 58) :2006
25	Total Phosphate	mg/l	BLQ(LOQ:0.02)	IS : 3025 (Part 31) - 1988

Note:- BLQ - Below the Limit of Quantification, LOQ- Limit of Quantification, mg/l - Milligrams per liter.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

Authorized Signatory

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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Panoru

Report No. : HECSL/MB/013/040722
Report Date : 07/07/2022

Sample Description : WATER
Sample Mark : Marine Water-Surface
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 30/06/2022 - 02/07/2022
Analysis Commenced On : 02/07/2022

Completed On : 07/07/2022

S.No.	Parameters	Units	Results	Test Method
1	Faecal coliform	MPN/100ml	<2	IS 1622
2	Fish Eggs	per 100ml	Present	In house validated method
3	larvae	per 100ml	Present	In house validated method

Note:- MPN - Most Probable Number, <2 is Considered as Absent.

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

Authorized Signatory

SIVAPRAKASAM. M
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TEST REPORT

Name of the Client : M/S. Indian Oil LNG Pvt Ltd.,
Address of the Client : Ennore

Report No. : HECSL/AN/001-010/020722
Report Date : 07/07/2022

Sample Description : Noise Monitoring (Ambient)
Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd
Sampling/received Date : 01/07/2022 -02/07/2022

S.No	Location	Day Noise Level in dB(A)	Night Noise Level in dB(A)
1	STV Area	61.5	58.4
2	HP LNG Area	57.4	53.7
3	CPP Area	47.9	44.1
4	Truck Loading Area	45.6	42.6
5	Jetty	64.5	61.4
6	BOG	63.6	60.8
7	Utility Area	57.0	54.2
8	Ware House	56.1	52.9
9	Fire Water Pump House Area	54.7	51.7
10	MSO Area	59.7	55.3

Limits set by CPCB:

i. Industrial Area : Day Time-75 dB (A); Night Time-70 dB (A).
ii. Commercial Area : Day Time-65 dB (A); Night Time-55 dB (A).
iii. Residential Area : Day Time-55 dB (A); Night Time-45 dB (A).
iv. Silence Zone : Day Time-50 dB (A); Night Time-40 dB (A).

End of Report

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 032

Authorized Signatory

SIVAPRAKASAM. M
Lab Manager

1. Report No.:	07/2022
2. Mock Drill Date & Time:	27.08.2022 & 12:13 hrs.
3. Place/ Location:	In Between LNG Storage Tanks 101 & 102
4. All Clear Time:	12:29 hrs.
5. Details of Emergency:	Spillage of LNG from flange LP Pump Discharge FCV 26 in between tanks 101 and 102, resulting in pool fire.
6. Reported By:	Mr. Dhanasekaran, Jr. Operation Engineer
7. Observer:	Mr. M.V. KARTHIKEYAN, Joint Director, DISH
8. Site Incident Controller:	Mr. Rajasekara Pandian, Chief Manager, Operations
9. Chief Incident Controller:	Mr. J. Sivakumar / Mr. K. Suresh

10. Objectives:

- To test the effectiveness of the developed onsite emergency plan.
- To test the effectiveness of the IOLPL team in handling emergency scenarios in LNG Tanks Storage area.

11. ECC Activation: Activated – Level 2

12. **Fire Pumps Availability:** Yes **(6/6 as per the Fire Plan Started)**

13. **Communication and Response of Emergency Teams:**

Events	Expected Response Time	Actual Response Time	Remarks, if any
Reporting of SIC	Within 1 minute through walkie or by nearest MCP activation	12:13 hrs.	
Reporting of CIC	Within 3 minutes of reporting the incident	12:14 hrs.	
Siren Activation after Initiation	Within 2 minutes from confirmation from CIC	12:14 hrs.	
Fire Team	1st Turnout to happen within 2 minutes upon receiving information from SIC	12:13 hrs.	
	2nd Turnout to happen within 4 minutes upon receiving information from SIC	12:15 hrs.	
Medical Team	Ambulance to happen within 90 seconds upon receiving information from SIC	12:15 hrs.	
Security Team	Within 3 minutes to reach their respective emergency response positions	12:15 hrs.	
Mutual Aid	KPL	12:17 hrs.	

E&M	N/A	N/A	
Others	N/A	N/A	

14. Sequence of Activity:

Timing	Description of the Mock Drill (the narrative of the situation, all actions) including response of emergency team and mitigation actions
12:13	Spillage of LNG from flange LP Pump Discharge FCV-26 in between tanks 101 and 102, resulting in pool fire. Message received from plant operator Mr. Shahameer Abdul through walkie talky, And MCP (001-MC-010) indication came on F&G system.
12:13	First turn out tender moved from BOG area along with fire officer (3 nos) and fire crew (5 fire men and 1 DCPO).
12:14	Informed to security dept, Securities at the Process gate, Utility gate kept open the doors for the fire tender movement.
12:14	SIC who was on plant rounds reached the spot and confirmed the leak to MCR and FCR. He informed that there is a pool fire in the area (dia approx. 4 m)
12:14	First turn out reached on spot with fire officer (3 nos) and fire crew.
12:14	Fire officer informed to fire control room for activating DVs of storage tank DV no. 101A, 101B, 101C, 102A, 102B, 102C– for the purpose of external cooling of the tanks.
12:14	Tank 101 & 102 all DV activated and same time all diesel pump started. After some time 16E, F, G&J one by one pump off and 16H pump continue running on 10 bar pressure maintained.
12:14	CIC informed MCR to activate the emergency siren.
12:14	Emergency siren activated, and PAGA announcement of all area to move to assembly point was made.
12:15	Second turn out and Ambulance moved from fire station to tank area with as well as fire axillary team & also 4 Rescue team members.
12:15	Operation SIC informed to MCR for depressurized the line – MCR responded that the line depressurizing has been initiated.
12:16	Electrical team confirmed the isolation of the supply near to the tanks, and confirmed the healthiness of the GEGs.
12:16	Arranged 6 no's Water Curtain Line, 2 no's Water spray line with TFT branch, 1 no's Foam line (High Expansion Foam Generator) and 1 no's Foam line (FB-10X).
12:16	Foam line started and foam poured over the spilled LNG area to minimize rapid vaporization and formation of vapor cloud.
12:17	Second turn out reached on spot with as well as fire axillary team.
12:17	KPL fire team moved from KPL fire station to Spot.
12:18	Ambulance reached on spot (Along with ambulance driver and 4 Rescue team members).
12:20	Found 1 casualty on spot same rescued and handed over to the rescue team and taken in ambulance.
12:21	Ambulance moved to OHC from spot with casualty.

	MCR Informed SIC and ECC that the header depressurization is 80% completed.
12:22	KPL fire team reached on spot with 1 no's fire officer, 1 no's DCPO and 06 no's fire man.
12:23	Ambulance reached at first aid center – Casualty was examined by the doctor and found unconscious, but the vitals are stable. O2 supply to the patient started.
12:24	KPL fire team arranged 01 water line with TP branch.
12:24	MCR Informed SIC that the header is completely depressurized.
12:24	Fire officer informed SIC & ECC that the Fire under control, boundary cooling of the support structures is in progress.
12:26	Isolated IV and Leakage arrested by mechanical team with SCBA set.
12:26	After leak arrested LEL checking done by mechanical team with SCBA set , LEL found zero.
12:27	All clear declared by CIC.
12:28	Fire officer informed to fire control room for closing DVs of storage tank DV no.101A, 101B, 101C, 102A, 102B, 102C.
12:29	All clear message announced in PAGA.
12:30	Head count was carried out by security team on all assembly point and cross verified.
12:33	De briefing done to all the participant by JDISH, CIC, and HSEF Manager.
12:57	Both Fire Tender return to fire station.
12:58	Normal Operations resumed

15. Head Count:

(a)	Total persons present in the installation before the drill	Employees: 48 Contractual: 133 Others: 13
(b)	Total persons available at Assembly point(s)	104 at assembly point, 56 on the spot, 06 at security post, 4 in First Aid, 1 in Fire Station, BD Gas 7, MCR, CPP, SS, FWPH, Utility -20.
(c)	Difference of head count after drill	Nil
(d)	Action taken to search the shortfall of head counts, if any	NA
(e)	Time of 'All Clear'	12:29 hrs.
(f)	Duration of Mock Drill (in Minutes)	16 Minutes

16. Observations & Recommendations:

Action plan for improvement based on the observations / findings of Mock Drill:

Sl. No.	Observations	Recommendations	Responsibility	Target Date	Status
1	Response of the emergency team members were found good and within the acceptable time.	Positive observation			
2					
3					
4					
5					

Prepared by	Reviewed by	Approved by
Govind Kumar Sahu	Dhakshinamurthy V	J. Sivakumar
Junior Fire Officer	Manager HSEF	Chief Operating Officer

FIRE SERVICE LICENSE

(Under Section 13 of the Tamil Nadu Fire Service Act 1985 and with Tamil Nadu Fire Service Rules 1909 Appendix III)

R.C.No. 03067 /B2/2022
LICENSE NO: 773 /2022 **DATE: 04.03.2022**

LICENSE is here by granted under section 13 of the Tamil Nadu Fire Service Act 1985, LIQUEFIED NATURAL GAS (LNG) IMPORT, STORAGE & REGASSIFICATION TERMINAL (LNG – 5 MILLION METRIC TONNES/ ANNUM, HIGH SPEED DIESEL (HSD) – 40 KL) in the name of M/S.INDIAN OIL LNG PRIVATE LIMITED within the jurisdiction of Ennore panchayat at 7/3B Part of Kattupalli Village and 1 part of Puzhuthivakkam Village, Inside Kamarajar Port Limited, Ennore, Chennai with Subject to the condition mentioned below noted there on and such other conditions as may be prescribed. The above premises inspected by Chennai Suburban Assistant District Officer (HQ), Mr.A.Thanapal and Ennore Station Officer-I, Mr.V.Palakararamasamy on 25.02.2022.

CONDITIONS

As per Tamil Nadu Fire Service Act 1985 Section 13 of Chapter II and appendix V of this Act.

1. **This License Is Valid For One Year From The Date Of Issue.**
2. **Regular License Has To Be Obtained From The Competent Authority.**
3. **The Following Fire & Life Safety Systems / Arrangements provided in the building should be kept in good working condition always.**
   - **I. Portable Fire Extinguisher – 306 No's, Fire Buckets – 32 No's & First Aid Box – 09 No's.**
   - **II. Hose Box – 82 No's, Hose Reel – 29 No's & Clean Agent System – 04 No's.**
   - **III. Water Cum Foam Monitor -12 No's & Double Hydrant Valve -156 No's.**
   - **IV. Manual Call Point -128 No's & Self Contained Breathing Apparatus – 16 No's.**
   - **V. 15133 LPM Diesel Pump – 05 No's, 15133 LPM Electric Pump – 04 No's & 4066 LPM Jockey Pump – 02 No's**
   - **VI. 5 Ponds with total capacity of 5500000 Liters only used for Firefighting.**
4. **If there is any deviation from the Govt. Rule and Act the LICENSE issued will stand cancelled.**
5. **Firefighting trained employee must be available in the premises to operate the equipment.**
6. **Mock Drill should be conducted once in six month.**
7. **Roof Ventilation should be provided at Fire Pump Room.**
8. **At all Foam Monitor terrain should be leveled for easy access of Foam Trolley.**
9. **Fire Vehicle damaged tire should be change.**

(Office seal with date)

- 4 MAR 2022

DISTRICT OFFICER
FIRE & RESCUE SERVICES
CHENNAI SUBURBAN DISTRICT
CHENNAI – 600 058

TO,

M/S.Indian Oil Lng Private Limited,
7/3b Part Of Kattupalli Village &1 Part Of Puzhuthivakkam Village,
Inside Kamarajar Port Limited, Ennore, Chennai.

...ந்மி' போராட்டம்

..., டெல்லியில், 'ஆம் ஆத்மி' அக்கட்சியினர் போராட்டம்

இளைஞர் காங்கிரஸ் பாத யாத்திரையில் பங்கேற்கிறார்

ராகுல்காந்தி மார்ச் முதல் வாரத்தில் தமிழகம் வருகை

கருணாநிதியை சந்திக்கவும் வாய்ப்பு

சென்னை, பிப்.20-

அகில இந்திய காங்கிரஸ் கமிட்டி துணைத்தலைவர் ராகுல்காந்தி மார்ச் மாதம் முதல் வாரத்தில் தமிழகம் வருகிறார். தமிழ்நாடு இளைஞர் காங்கிரஸ் சார்பில் நடைபெறும் பாத யாத்திரையில் அவர் பங்கேற்கிறார். மேலும், தி.மு.க. தலைவர் கருணாநிதியையும் அவர் சந்திக்க இருப்பதாக கூறப்படுகிறது.

பாத யாத்திரை

பாராளுமன்ற தேர்தல் நெருங்கி வரும் சூழ்நிலையில், காங்கிரஸ் தலைமையிலான மத்திய அரசின் 10 ஆண்டு சாதனைகளை மக்களிடம் எடுத்துச் செல்லும் விதமாக நாடு முழுவதும் இளைஞர் காங்கிரஸ் சார்பில் பாத யாத்திரை நடத்தப்பட்டு வருகிறது. அதில், அக்கட்சியின் துணைத் தலைவர் ராகுல்காந்தியும் பங்கேற்று வருகிறார்.

அந்த வகையில், தமிழ்நாடு இளைஞர் காங்கிரஸ் சார்பில், மார்ச் மாதம் 5-ந் தேதி முதல் 10-ந் தேதி வரை பாதயாத்திரை நடத்தப்பட உள்ளது. இந்த பாத யாத்திரை இறுதி கட்டத்தை எட்டும்போது, அதில் அகில இந்திய காங்கிரஸ் கட்சியின் துணைத்தலைவர் ராகுல்காந்தி பங்கேற்க உள்ளார்.

பயண திட்ட அறிக்கை தயார்

முதற்கட்டமாக, எந்த வழியில் இருந்து பாத யாத்திரையை தொடங்குவது என்று திட்டமிடப்பட்டது. தற்போது, வேதாரண்யத்தில் இருந்து தேவகோட்டை வரையும், விருதுநகரில் இருந்து ராமேஸ்வரம் வரையும் என 2 வழித்தடங்களில் பாத யாத்திரை நடத்த முடிவு செய்யப்பட்டுள்ளது. இந்த பகுதிகளில் பாதயாத்திரைக்கான வழிகளை, தமிழ்நாடு இளைஞர் காங்கிரஸ் தலைவர் விஜய் இளஞ்செழியன் மற்றும் நிர்வாகிகள் நேற்று பார்வையிட்டு ஆய்வு செய்தனர்.

அதனைத் தொடர்ந்து, பாத யாத்திரை திட்டத்தை தயாரித்துக்கொண்டு, இன்று (வியாழக்கிழமை) டெல்லி செல்கிறார். அங்கு, ராகுல் காந்தியிடம் பயண திட்ட அறிக்கை வழங்கப்படுகிறது. இந்த 2 வழித்தடங்களில் அவர் ஒன்றை தேர்வு செய்வார் என எதிர்பார்க்கப்படுகிறது.

கருணாநிதியை சந்திக்க வாய்ப்பு

காங்கிரஸ் அரசின் சாதனைகளை விளக்கி தமிழகத்தில் நடைபெற உள்ள பாத யாத்திரை இறுதி நாளில், ராகுல்காந்தி பங்கேற்று இளைஞர் காங்கிரஸ் நிர்வாகிகளுடன் சில கிலோ மீட்டர்கள் நடை பயணம் மேற்கொள்ள உள்ளார்.

மேலும், பாத யாத்திரையை முடித்துக்கொண்டு சென்னை வரும் அவர், தி.மு.க. தலைவர் கருணாநிதியையும் சந்தித்து பேச வாய்ப்பு உள்ளதாக கூறப்படுகிறது. ராகுல்காந்தியின் தமிழகம் வருகையையொட்டி, தமிழ்நாடு காங்கிரஸ் கட்சியினர் உற்சாகம் அடைந்துள்ளனர்.

...தயாராக இல்லை

...மைப்பவர்கள்

...யில் தமிழக முதல்-அமைச்சர் ஜெயலலிதா அறிவித்திருப்பதை இந்திய கம்யூனிஸ்டு கட்சி மனதார பாராட்டுகிறது. பேரறிவாளனின் தாயார் அடைந்த மகிழ்ச்சியை விட அதிக மகிழ்ச்சி அடைகிறோம்.

இவ்வாறு தா.பாண்டியன் கூறினார்.

movements.

The other option was to put the four islanders in the Special Camp for refugees. It was now for the State government to take a decision in the matter, Mr. Pugalenthi said.

According to police sources, the four Sri Lankan nationals would have to be accommodated in special or ordinary refugee camps.

The practice has been that ... release the convicts, the Working Group on Human Rights in India and the UN national convener Henri Tiphagne said in case some of the convicts had no family or relatives in Tamil Nadu, human rights organisations like the People's Watch would be willing to generously provide long-term shelters and surety for all those who required the same.

... members of various Tamil outfits welcomed the Tamil Nadu Cabinet's decision on release of the convicts. They distributed sweets to passers-by on Wednesday.

Members of the ... (DITP), which ... campaign for the commutation of the death sentence for the trio in September 2011 when the President rejected their mercy petitions ...

... Deputy General Secretary of DITP, said his first thanks would go to the Supreme Court which had given a verdict acceptable to the family. "As far as I know, this is the first revolutionary verdict. We are indeed indebted to the State government which has taken a stunning decision to release the three convicts if the Central government does not give permission to do so within three days.

... tions for the ... the death sentence ... those more than ... ago.

According to the Prison Superintendent, V. Karuppannan, Murugan, Santhan and Perarivalan were all ... receiving the news of the State Cabinet's decision on their release.

"We have not so far received any official communication about the release of the convicts," he said.

Govt. stand on prohibition

CHENNAI: The State government is willing to consider prohibition but such a move would serve little purpose unless the neighbouring States too take a ... decision, Prohibition and Excise Minister Natham R. Viswanathan told the Assembly on Wednesday. Intervening in a discussion on the budget, when Puthiya Tamizhagam MLA K. Krishnasamy was speaking, the Minister said this was the State's stand as introducing prohibition in the absence of neighbouring States doing so would make implementation impractical.

Is it a crime to paste posters, asks Alagiri

L. Srikrishna

MADURAI: "Many Dravida Munnetra Kazhagam (DMK) workers who had pasted posters hailing me were suspended from the party...is this an offence," asked M.K. Alagiri, former Union Minister and Madurai Lok Sabha MP, who was removed from the post of south zone organising secretary and also suspended by the party high command recently.

Speaking at a marriage of a party functionary and his loyalist here on Wednesday, Mr. Alagiri said "during my trip abroad, I heard about the suspension of as many as 10 functionaries and I enquired with the party president to inquire about it on my return ... for a pause, I too was suspended again for reasons not known."

The former minister said the party men (placed under suspension) had done no crime or indulged in any anti-party activities. They had just pasted posters informing public about my much published interview to a private television channel ... which they were used. "No ... party should suffer such humiliation," he said. At a time, when elections to the Lok Sabha are fast approaching, such intra-party ... may affect the ... of candidates ... it, Mr. Alagiri said and added that the high command had given him the post of south zone organising secretary and taken away on their own.

'Want to continue to serve'

"Whether in power or not, I wish to continue to serve the ... and the needy," he said amid cheers.

Stalin's appeal to party cadre

Special Correspondent

CHENNAI: Dravida Munnetra Kazhagam Treasurer M.K. Stalin on Wednesday appealed to the party cadres not to celebrate his birthday falling on March 1 in an ostentatious manner. In a statement Mr. Stalin requested the party cadres not to embarrass him by putting up vinyl hoardings, banners, posters and placards.

They should be strictly avoided. Polite and quiet behaviour was needed. Pompous and glory were always disliked, he said.

The focus of the party cadres should be on the forthcoming Parliament elections.

Youth Wing members should extend help to aged people, poor and downtrodden, orphaned children, transgenders and the differently-abled; conducting youth wing meetings through which holding election campaigns, distributing books to libraries named after C.N. Annadurai and M. Karunanidhi, recognising the services of senior persons in the party were some of the activities that he welcomed, he said.

Katchatheevu issue: SC grants time to Karunanidhi to respond

... Venkatesan

NEW DELHI: The Supreme Court on Wednesday granted ... weeks time to DMK president M. Karunanidhi to ... his response to the Centre's reply that Katchatheevu could not be retrieved from Sri Lanka as pleaded by him in his writ petition. A three-judge Bench of Justices B.S. Chauhan, M.Y. Eqbal and A.K. Sikri granted this on a request made by counsel V.G. Pragasam, appearing for the petitioner, Mr. Karunanidhi.

The Centre had made it clear that the question of retrieval of Katchatheevu did not arise as no territory belonging to India was ceded nor sovereignty relinquished to Sri Lanka.

Therefore the contention of Mr. Karunanidhi that Katchatheevu was ceded to Sri Lanka was not correct and contrary to official records.

ANNEXURE- III

CONSENT FOR ESTABLISHMENT AND CONSENT FOR OPERATION

TAMILNADU POLLUTION CONTROL BOARD

232962

CONSENT ORDER NO. 160124007851 DATED: 11/11/2016.

PROCEEDINGS NO.T12/TNPCB/F.0770AMB/RL/AMB/A/2016 DATED: 11/11/2016

SUB: TNPC Board-Consent for Establishment-M/s. INDIANOIL LNG PRIVATE LTD , S.F. No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port, KATTUPALLI village, Ponneri Taluk and Tiruvallur District - for the establishment or take steps to establish the industry under Section 21 of the Air(Prevention and control of Pollution)Act,1981, as amended in 1987(Central Act. 14 of 1981)-Issued -Reg.

REF: 1. Unit's application No. 4007851, dated 06/05/2016/09-09-2016/ 05-11-2016.
2. IR.No : F.0770AMB/RL/DEE/AMB/2016 dated 23/09/2016.
3. Board's (Technical Sub Committee) Resolution Item No.134 –04, dated: 26.10.2016.

Consent to establish or take steps to establish is hereby granted under Section 21 of the Air (Prevention and control of Pollution) Act,1981, as amended in 1987 and the Rules and Orders made there under to

The Chief Executive Officer,
M/s . INDIANOIL LNG PRIVATE LTD
S.F No.7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port,
KATTUPALLI Village,
Ponneri Taluk,
Tiruvallur District.

Authorizing occupier to establish or take steps to establish the industry in the site mentioned below:

S.F No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port,
KATTUPALLI Village,
Ponneri Taluk,
Tiruvallur District.

This Consent to establish is valid upto **March 31, 2023**, or till the industry obtains consent to operate under Section 21 of the Air (Prevention and control of Pollution) Act, 1981, as amended in 1987 whichever is earlier subject to special and general conditions enclosed.

15/11/16

Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

15/11/16

To

The Chief Executive Officer,M/s.INDIANOIL LNG PRIVATE LTD,
Ennore LNG Import, Storgae & Regasifictaion Terminal Project, Inside the Kamarajar Port, Valllur Post, Ponneri Taluk, Thiruvallur District,
Pin: 600120

Copy to:

1.The Commissioner, MEENJUR-Panchayat Union, Ponneri Taluk, Tiruvallur District .

2. The District Environmental Engineer, Tamil Nadu Pollution Control Board, AMBATTUR.

TAMILNADU POLLUTION CONTROL BOARD

SPECIAL CONDITIONS

1. This consent to establish is valid for establishing the facility for the manufacture of products/ byproducts (Col. 2) at the rate (Col 3) mentioned below. Any change in the product/byproduct and its quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Sl. No.	Description	Quantity	Unit
	Product Details		
1.	(1) Receipt of LNG through ships and unloading the same into storage tanks of capacity 2 x 1,80,000 Cubic meters. (2) Re-gasification facilities for converting LNG to gas. (3) Despatch of LNG through Road tankers.	5	MMTPA
2.	Captive Power Plant consisting of 3 nos of 9.425 MW each Gas Engine Generator using Re-gasified LNG as fuel	28	MW

2. This consent to establish is valid for establishing the facility with the below mentioned emission/noise sources along with the control measures and/or stack .Any change in the emission source/control measures/change in stack height has to be brought to the notice of the Board and fresh consent has to be obtained if necessary.

I	**Point source emission with stack :**			
Stack No.	**Point Emission Source**	**Air pollution Control measures**	**Stack height from Ground Level in m**	**Gaseous Discharge in Nm3/hr**
01	Flare	Stack	60	72345.6
05	DG set	Stack	30	21195
06	Fire Water Pump - Engine 1	Stack	30	11636
07	Fire Water Pump - Engine 2	Stack	30	11636
08	Fire Water Pump - Engine 3	Stack	30	11636
09	Fire Water Pump - Engine 4	Stack	30	11636
10	Fire Water Pump - Engine 5	Stack	30	11636
02	GEG-1 (9.425 MW)	Stack	30	118800
03	GEG-2 (9.425 MW)	Stack	30	118800
04	GEG-3 (9.425 MW)	Stack	30	118800
II	**Fugitive/Noise emission :**			
Sl. No.	**Fugitive or Noise Emission sources**	**Type of emission**	**Control measures**	
1.	DG Set (1000 KVA)	Noise	Acoustic enclosures	

3. **Additional Conditions:**

1. The unit shall provide acoustic enclosure with stack to the DG set, Fire Pump and Gas Engine Generators and shall ensure that the emission from the DG set, Flare Stack, Fire Pump and Gas Engine Generators satisfy the AAQ/Emission standards prescribed by the Board.
2. The unit shall adhere to the Ambient Noise level standards prescribed by the Board.
3. The unit has to ensure a safe boundary zone around the site to avoid damage to the nearby area.
4. The unit shall maintain the spark arrestors efficiently on the tankers arriving for filling up operations in the premises to prevent fire hazard in that area.
5. The unit shall take adequate precautions against static electricity.
6. The unit shall comply with the conditions stipulated in the Environmental and CRZ Clearances accorded by MOEF, GOI vide F.No.11-30/2011-IA.III dated 10.02.2014 and 22.04.2016.
7. The unit shall furnish the details on variety of trees planted/to be planted and number of trees planted/proposed to be planted and area earmarked for green belt development and submit the same with photo graphs at the time of application for CTO.
8. The unit shall apply for the separate consent of the Board for laying pipe line from the unit to the industries and domestic sectors as reported.
9. The unit shall obtain amendment in Environmental Clearance and CRZ clearance from MoEF for inclusion of handling capacity of LNG terminal (5 MMTPA),capacity of storage tanks (2 x 1,80,000 Cubic meters)and Gas Engine Generators as Captive power plant (3 x9.425 MW) and furnish the same while applying for Consent to operate of the Board.
10. In case of revision of consent fee by the Government, the unit shall remit the difference in amount within one month from date of notification. Failing to remit the consent fee, this consent order will be withdrawn without any notice and further action will be initiated against the unit as per law.

Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

15/11/16

TAMILNADU POLLUTION CONTROL BOARD

GENERAL CONDITIONS

1. This consent to establish cannot be construed as consent to operate and the unit shall not commence the operation without obtaining the Consent to operate.
2. The applicant shall make a request for grant of consent to operate at least thirty days, before the commissioning of trial production.
3. Any Change in the details furnished in the conditions has to be brought to the notice of the Board and got approved by the Board, before obtaining consent to operate under the said Act.
4. The unit has to comply with the provisions of Public Liability Insurance Act, 1991 to provide immediate relief in the event of any hazard to human beings, other living creatures/plants and properties while handling and storage of hazardous substances (wherever applicable).
5. Consent to operate will not be issued unless the unit complies with the conditions of consent to establish.
6. The unit shall provide adequate water sprinklers for the control of dust emission during the loading and unloading of construction material so as to minimize the dust emission.
7. The unit shall provide water sprinklers along the temporary roads inside the premises to avoid fugitive dust emission during the vehicle movements.
8. The unit shall develop green belt of adequate width around the premises.
9. In case there is any change in the management, the unit shall inform the change with relevant documents immediately.

15/11/16

Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

15/11/16

TAMILNADU POLLUTION CONTROL BOARD

CONSENT ORDER NO. 160114007851 DATED: 11/11/2016.

PROCEEDINGS NO.T12/TNPCB/F.0770AMB/RL//AMB/W/2016 DATED: 11/11/2016

SUB: TNPC Board-Consent for Establishment-M/S INDIANOIL LNG PRIVATE LTD S.F No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port, KATTUPALLI Village, Ponneri Taluk, Tiruvallur District - for the establishment or take steps to establish the industry under Section 25 of the Water (Prevention and control of Pollution)Act,1974, as amended in 1988(Central Act 6 of 1974)- Issued- Reg.

REF: 1. Unit's application No. 4007851, dated 06/05/2016/09-09-2016/ 05-11-2016.
2. IR.No : F.0770AMB/RL/DEE/AMB/2016 dated 23/09/2016.
3. Board's (Technical Sub Committee) Resolution Item No.134 –04, dated: 26.10.2016.

Consent to establish or take steps to establish is hereby granted under Section 25 of the Water (Prevention and control of Pollution) Act,1974, as amended in 1988(Central Act 6 of 1974) (hereinafter referred to as 'The Act') and the Rules and Orders made there under to

The Chief Executive Officer,
INDIANOIL LNG PRIVATE LTD

Authorizing occupier to establish or take steps to establish the industry in the site mentioned below:

S.F. No.7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port,
KATTUPALLI Village,
Ponneri Taluk,
Tiruvallur District.

This Consent to establish is valid upto **March 31, 2023**, or till the industry obtains consent to operate under Section 25 of the Water (Prevention and control of Pollution) Act, 1974, as amended in 1988 whichever is earlier subject to special and general conditions enclosed.

15/11/16

Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

15/11/16

To
The Chief Executive Officer,M/s.INDIANOIL LNG PRIVATE LTD,
Ennore LNG Import, Storgae & Regasifictaion Terminal Project, Inside the Kamarajar Port, Valllur Post, Ponneri Taluk, Thiruvallur District,
Pin: 600120

Copy to:

1.The Commissioner, MEENJUR-Panchayat Union, Ponneri Taluk, Tiruvallur District .
2. The District Environmental Engineer, Tamil Nadu Pollution Control Board, AMBATTUR.
3. The JCEE-Monitoring, Tamil Nadu Pollution Control Board, Chennai.
4. File

TAMILNADU POLLUTION CONTROL BOARD

SPECIAL CONDITIONS

1. This consent to establish is valid for establishing the facility for the manufacture of products/ byproducts (Col. 2) at the rate (Col 3) mentioned below. Any change in the product/byproduct and its quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Sl. No.	Description	Quantity	Unit
	Product Details		
1.	(1) Receipt of LNG through ships and unloading the same into storage tanks of capacity 2 x 1,80,000 Cubic meters. (2) Re-gasification facilities for converting LNG to gas. (3) Despatch of LNG through Road tankers.	5	MMTPA
2.	Captive Power Plant consisting of 3 nos of 9.425 MW each Gas Engine Generator using Re-gasified LNG as fuel	28	MW

2. The unit shall provide Sewage Treatment Plant and /or Effluent Treatment Plant as indicated below.

a	**Sewage Treatment Plant:**		
Treatment status: Septic Tank and SP/DT			
SL. No.	Name of the Treatment Unit	No. of Units	Dimensions in metres
1.	Soak Pit	6	1.5 x 1.5 x 2
2.	Septic Tank	6	2.3 x 1.1 x 1.8
b	**Effluent Treatment Plant:**		
Treatment status: No trade effluent and hence does not arise			
SL. No.	Name of the Treatment Unit	No. of Units	Dimensions in metres
1.			
2.			
3.			
4.			

3. This consent to establish is valid for establishing the facility with the below mentioned outlets for the discharge of sewage/trade effluent. Any change in the outlets and the quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Outlet No.	Description of Outlet	Maximum daily discharge in KLD	Point of disposal
Effluent Type : Sewage			
1.	Sewage	3.96	On Industrys own land
Effluent Type : Trade Effluent			

4. **Additional Conditions:**

தமிழ்நாடு

TAMILNADU POLLUTION CONTROL BOARD

1. The unit shall provide septic tank followed by soak pit for the treatment and disposal of sewage.
2. The unit shall ensure that no trade effluent shall be generated from its activity.
3. The unit shall apply and obtain Authorization under Hazardous and Other Waste (M&TM) Rules, 2016 for disposal of hazardous wastes generated if any.
4. The unit shall dispose solid waste if any scientifically then and there without any accumulation.
5. The unit shall comply with the conditions stipulated in the Environmental and CRZ Clearances accorded by MOEF, GOI vide F.No.11-30/2011-IA.III dated 10.02.2014 and 22.04.2016.
6. The unit shall notify the site as per schedule -7 of the manufacture, storage and import of Hazardous chemical Rules 1989 as amended.
7. The unit shall adopt onsite/off site emergency plan as per Rule 13 of the manufacture storage and import of Hazardous chemicals Rules, 1989 as amended before commissioning the activity.
8. The unit shall carry out its operation with valid policy under Public Liability Insurance Act, 1991.
9. The unit shall carry out mock drill and safety audit periodically.
10. The unit shall follow the measures suggested in the risk assessment report.
11. The unit shall follow the safety emergency plan as per the safety guidelines of OISD.
12. The unit shall comply with all the conditions stipulated by the Tamil Nadu Coastal Zone Management Authority (TNCZMA) vide letter No. 5132/EC.3/2013-1 dated 20.09.2013.
13. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.
14. Leak detection / warning system shall be provided at strategic locations. Necessary control measures capable of remote operation to shut down the leakage, if any, should be provided.
15. The smooth and safe operation of the system will be ensured by incorporating a computerized SCADA (Supervisor Control And Data Acquisition) system. Any leakage in the pipeline shall be immediately detected by the Computer system and product pumping shall be immediately cut off.
16. 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.
17. The project shall be carried out as per international standards in vogue and duly certified by competent authorities before commissioning.
18. Oil Spill Contingency Management Plan shall be put in place along with the dedicated staff to deal with Oil spill in and around the port area shall be provided in the port. No oily wastes shall be discharged into the water bodies/mangrove areas.
19. The unit shall obtain NOC /Clearance confirming that all the fire fighting provisions are as per standards specified by the Chief Controller of Explosives / Petroleum & Explosives Safety Organization (PESO) for the storage tanks.
20. The unit shall establish additional storage tanks, only after obtaining consent from the Board.
21. The unit shall furnish the details on variety of trees planted/to be planted and number of trees planted/proposed to be planted and area earmarked for green belt development and submit the same with photo graphs at the time of application for CTO.
22. The transporter should ensure that the driver of the vehicle should carry TREM card during transportation as per Motor Vehicle Act.
23. The unit shall obtain amendment in Environmental Clearance and CRZ clearance from MoEF for inclusion of handling capacity of LNG terminal (5 MMTPA),capacity of storage tanks (2 x 1,80,000 Cubic meters)and Gas Engine Generators as Captive power plant (3 x9.425 MW) and furnish the same while applying for Consent to operate of the Board.
24. In case of revision of consent fee by the Government, the unit shall remit the difference in amount within one month from date of notification. Failing to remit the consent fee, this consent order will be withdrawn without any notice and further action will be initiated against the unit as per law.

Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

15/11/16

TAMILNADU POLLUTION CONTROL BOARD

GENERAL CONDITIONS

1. This consent to establish cannot be construed as consent to operate and the unit shall not commence the operation without obtaining the Consent to operate.
2. The applicant shall make a request for grant of consent to operate at least thirty days, before the commissioning of trial production.
3. Any Change in the details furnished in the conditions has to be brought to the notice of the Board and got approved by the Board, before obtaining consent to operate under the said Act.
4. The unit has to comply with the provisions of Public Liability Insurance Act, 1991 to provide immediate relief in the event of any hazard to human beings, other living creatures/plants and properties while handling and storage of hazardous substances (wherever applicable).
5. Consent to operate will not be issued unless the unit complies with the conditions of consent to establish.
6. The unit shall provide adequate water sprinklers for the control of dust emission during the loading and unloading of construction material so as to minimize the dust emission.
7. The unit shall provide water sprinklers along the temporary roads inside the premises to avoid fugitive dust emission during the vehicle movements.
8. The unit shall develop green belt of adequate width around the premises.
9. In case there is any change in the management, the unit shall inform the change with relevant documents immediately.

15/11/16

Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

15/11/16

TAMILNADU POLLUTION CONTROL BOARD

Category of the Industry :

RED

CONSENT ORDER NO. 2208242538887 DATED: 16/04/2022.

PROCEEDINGS NO.T2/TNPCB/F.0448GMP/RL/GMP/A/2022 DATED: 16/04/2022

SUB: Tamil Nadu Pollution Control Board - RENEWAL OF CONSENT –M/s. INDIANOIL LNG PRIVATE LTD , S.F.No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port, KATTUPALLI village, Ponneri Taluk and Tiruvallur District - Renewal of Consent for the operation of the plant and discharge of emissions under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 as amended in 1987 (Central Act 14 of 1981) –Issued- Reg.

REF: 1. Proceedings No. T2/TNPCB/F.0448GMP/RL/GMP/A/2021, dated: 25/08/2021
2. Units application No.42538887, dated: 22/01/2022
3. IR. No. F.0448GMP/RL/DEE/GMP/2022, dated: 17/03/2022

RENEWAL OF CONSENT is hereby granted under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 as amended in 1987 (Central Act 14 of 1981) (hereinafter referred to as "The Act") and the rules and orders made there under to

The Chief Executive Officer
M/s.INDIANOIL LNG PRIVATE LTD,
S.F.No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port,
KATTUPALLI village,
Ponneri Taluk,
Tiruvallur District.

Authorizing the occupier to operate the industrial plant in the Air Pollution Control Area as notified by the Government and to make discharge of emission from the stacks/chimneys.

This is subject to the provisions of the Act, the rules and the orders made there under and the terms and conditions incorporated under the Special and General conditions stipulated in the Consent Order issued earlier and subject to the special conditions annexed.

This RENEWAL OF CONSENT is valid for the period ending March 31, 2025

RAMASAMY RAJAMANICKAM Digitally signed by RAMASAMY RAJAMANICKAM Date: 2022.04.17 10:59:57 +05'30'

For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

SPECIAL CONDITIONS

1. This renewal of consent is valid for operating the facility for the manufacture of products (Col. 2) at the rate (Col. 3) mentioned below. Any change in the products and its quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Sl. No.	Description	Quantity	Unit
	Product Details		
1.	(1) Receipt of LNG through ships and unloading the same into storage tanks of capacity 2 x 1,80,000 Cubic meters. (2) Re-gasification facilities for converting LNG to gas. (3) Despatch of LNG through Road tankers.	5	MMTPA
2.	Captive Power Plant consisting of GEGs - 2 x 9.425 MW - Operating and 1 x 9.425 MW standby.(Regassified-LNG used as Fuel)	18.85	MW

2. This renewal of consent is valid for operating the facility with the below mentioned emission/noise sources along with the control measures and/or stack. Any change in the emission source/control measures/change in stack height has to be brought to the notice of the Board and fresh consent/Amendment has to be obtained.

I	Point source emission with stack :			
Stack No.	**Point Emission Source**	**Air pollution Control measures**	**Stack height from Ground Level in m**	**Gaseous Discharge in Nm3/hr**
1	Flare	Stack	60	105147
2	GEG 1 (9.425 MW)	Acoustic enclosures with stack	30	94100
3	GEG 2 (9.425 MW)	Acoustic enclosures with stack	30	94100
4	GEG 3 (9.425 MW)	Acoustic enclosures with stack	30	94100
5	DG SET 1000 KVA - 1 No	Acoustic enclosures with stack	30	14608
6	Fire Water Pump Engine 1	Stack	12.5	8838
7	Fire Water Pump Engine 2	Stack	12.5	8838
8	Fire Water Pump Engine 3	Stack	12.5	8838
9	Fire Water Pump Engine 4	Stack	12.5	8838
10	Fire Water Pump Engine 5	Stack	12.5	8838
11	DG 750 KVA - 1 No	Acoustic enclosures with stack	12	9035
II	**Fugitive/Noise emission :**			
Sl. No.	**Fugitive or Noise Emission sources**	**Type of emission**	**Control measures**	
1.	DG SET (750 KVA)	Noise	Acoustic Enclosure with stack	
2.	DG SET (1000 KVA)	Noise	Acoustic Enclosure with stack	

TAMILNADU POLLUTION CONTROL BOARD

Special Additional Conditions:

i. The unit shall install the approved retrofit emission control device/equipment with at least 70% Particulate matter reduction efficiency on all DG sets with capacity of 125 KVA and above or otherwise the unit shall be shift to gas based generators within the time frame prescribed in the notification No. TNPCB/Labs/DD(L)02151/2019 dated 10.06.2020 issued by TNPCB.

ii. The unit shall obtain No Objection Certificate (NOC) from the Tamil Nadu Bio Diversity Board /National Bio Diversity Authority if the unit is using any Biological resources or knowledge associated thereto as per the provisions of Biological Diversity Act 2002.

Additional Conditions:

1. The unit shall operate and maintain the APC measures efficiently and continuously so as to adhere to the Ambient Air Quality / Emission standards prescribed by the Board.
2. The unit shall conduct AAQ/SM/ANL through TNPCB lab periodically and furnish ROA to the Board.
3. The unit shall ensure that all the fire vapour release points related to safety measures are hooked up to flare lines so that it is ultimately burnt in flare stack.
4. The unit shall ensure the emission from the Flare Stack, Gas Engine Generator, DG set and Fire Pump Engine satisfies the National Ambient Air Quality (NAAQ) / Emission Standard prescribed by the Board.
5. The unit shall continue to develop green belt within the premises.
6. The unit shall not use 'use and throwaway plastics' such as plastic sheets used for food wrapping, spreading on dining table etc., plastic plates, plastic coated tea cups, plastic tumbler, water pouches and packets, plastic straw, plastic carry bag and plastic flags irrespective of thickness, within the industry premises. Instead it shall encourage use of eco friendly alternative such as banana leaf, areca nut palm plate, stainless steel, glass, porcelain plates/cups, cloth bag, Jute bag etc.
7. In case of revision of consent fee by the Government, the unit shall remit the difference in amount within one month from the date of notification, failing to remit the consent fee, this consent order will be withdrawn without any notice and further action will be initiated against the unit as per law.

RAMASAMY RAJAMANICKAM

Digitally signed by RAMASAMY RAJAMANICKAM
Date: 2022.04.17 11:00:18 +05'30'

For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

To
The Chief Executive Officer,
M/s.INDIANOIL LNG PRIVATE LTD,
IndianOil LNG Private Limited,
Indian Oil Bhavan,
139, Nugambakkam High Road, Chennai,
Pin: 600034

Copy to:

1.The Commissioner, MEENJUR-Panchayat Union, Ponneri Taluk, Tiruvallur District .
2. The District Environmental Engineer, Tamil Nadu Pollution Control Board, GUMMIDIPOONDI.
3. The JCEE-Monitoring, Tamil Nadu Pollution Control Board, Chennai.
4. File

TAMILNADU POLLUTION CONTROL BOARD

Category of the Industry :

RED

CONSENT ORDER NO. 2208142538887 DATED: 16/04/2022.

PROCEEDINGS NO.T2/TNPCB/F.0448GMP/RL/GMP/W/2022 DATED: 16/04/2022

SUB: Tamil Nadu Pollution Control Board - RENEWAL OF CONSENT – M/s. INDIANOIL LNG PRIVATE LTD , S.F.No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port, KATTUPALLI village, Ponneri Taluk and Tiruvallur District - Renewal of Consent for the operation of the plant and discharge of sewage and/or trade effluent under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988 (Central Act 6 of 1974) – Issued- Reg.

REF: 1. Proceedings No. T2/TNPCB/F.0448GMP/RL/GMP/A/2021, dated: 25/08/2021
2. Units application No.42538887, dated: 22/01/2022
3. IR. No. F.0448GMP/RL/DEE/GMP/2022, dated: 17/03/2022

RENEWAL OF CONSENT is hereby granted under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988 (Central Act. 6 of 1974) (hereinafter referred to as "The Act") and the rules and orders made there under to

The Chief Executive Officer
M/s.INDIANOIL LNG PRIVATE LTD,
S.F.No. 7/3B part of Kattupalli Village and 1 part of Puzhuthivakkam Village inside Kamarajar Port,
KATTUPALLI Village ,
Ponneri Taluk ,
Tiruvallur District .

Authorising the occupier to make discharge of sewage and /or trade effluent.

This is subject to the provisions of the Act, the rules and the orders made there under and the terms and conditions incorporated under the Special and General conditions stipulated in the Consent Order issued earlier and subject to the special conditions annexed.

This RENEWAL OF CONSENT is valid for the period ending March 31, 2025

RAMASAMY RAJAMANICKAM
Digitally signed by RAMASAMY RAJAMANICKAM
Date: 2022.04.17 11:00:55 +05'30'

For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

TAMILNADU POLLUTION CONTROL BOARD

SPECIAL CONDITIONS

1. This renewal of consent is valid for operating the facility for the manufacture of products/byproducts (Col. 2) at the rate (Col 3) mentioned below. Any change in the product/byproduct and its quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Sl. No.	Description	Quantity	Unit
	Product Details		
1.	(1) Receipt of LNG through ships and unloading the same into storage tanks of capacity 2 x 1,80,000 Cubic meters. (2) Re-gasification facilities for converting LNG to gas. (3) Despatch of LNG through Road tankers.	5	MMTPA
2.	Captive Power Plant consisting of GEGs - 2 x 9.425 MW - Operating and 1 x 9.425 MW standby.(Regassified-LNG used as Fuel)	18.85	MW

2. This renewal of consent is valid for operating the facility with the below mentioned outlets for the discharge of sewage/trade effluent. Any change in the outlets and the quantity has to be brought to the notice of the Board and fresh consent has to be obtained.

Outlet No.	Description of Outlet	Maximum daily discharge in KLD	Point of disposal
Effluent Type : Sewage			
1.	Sewage	3.96	On Industrys own land
Effluent Type : Trade Effluent			

TAMILNADU POLLUTION CONTROL BOARD

Special Additional Conditions:

The unit shall obtain No Objection Certificate (NOC) from the Tamil Nadu Bio Diversity Board /National Bio Diversity Authority if the unit is using any Biological resources or knowledge associated thereto as per the provisions of Biological Diversity Act 2002.

Additional Conditions:

1. The unit shall furnish the MoU made with M/s Kamrajar Port as per MORPOL conditions, within three months.
2. The unit shall treat the sewage in septic tank and dispose through soak pit arrangements.
3. The unit shall ensure that no trade effluent is generated from its activity under any circumstances.
4. The unit shall comply with the provisions of Hazardous and Other Wastes (M&TM) Rules, 2016.
5. The unit shall operate with valid licence under Public Liability Insurance Act, 1991 & permission of DISH.
6. The unit shall follow the safety measures as suggested in the Risk Analysis Report.
7. The unit shall have updated on-site and off-site disaster management plan and conduct regular training for all personal to be involved in handling, storing and processing so as to handle the emergency situations like major fire if any, in the quickest possible time.
8. The unit shall update on-site and off-site emergency plan regularly and implement the recommendations mentioned therein and comply with the provisions of Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
9. The unit shall carry out mock drill and safety audit periodically.
10. The unit shall not use 'use and throwaway plastics' such as plastic sheets used for food wrapping, spreading on dining table etc., plastic plates, plastic coated tea cups, plastic tumbler, water pouches and packets, plastic straw, plastic carry bag and plastic flags irrespective of thickness, within the industry premises. Instead it shall encourage use of eco friendly alternative such as banana leaf, areca nut palm plate, stainless steel, glass, porcelain plates/cups, cloth bag, Jute bag etc.,
11. In case of revision of consent fee by the Government, the unit shall remit the difference in amount within one month from the date of notification, failing to remit the consent fee, this consent order will be withdrawn without any notice and further action will be initiated against the unit as per law.

RAMASAMY RAJAMANICKAM

Digitally signed by RAMASAMY RAJAMANICKAM
Date: 2022.04.17 11:01:14 +05'30'

For Member Secretary,
Tamil Nadu Pollution Control Board,
Chennai

To
The Chief Executive Officer,
M/s.INDIANOIL LNG PRIVATE LTD,
IndianOil LNG Private Limited,
Indian Oil Bhavan,
139, Nugambakkam High Road, Chennai,
Pin: 600034

Copy to:

1.The Commissioner, MEENJUR-Panchayat Union, Ponneri Taluk, Tiruvallur District .
2. The District Environmental Engineer, Tamil Nadu Pollution Control Board, GUMMIDIPOONDI.
3. The JCEE-Monitoring, Tamil Nadu Pollution Control Board, Chennai.
4. File

ANNEXURE- IV

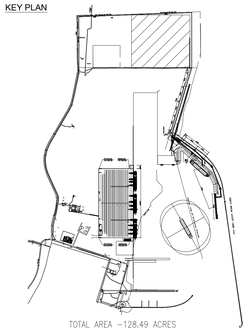
OVERALL PLOT PLAN DRAWING

Prevailing Wind

N
W E
S

NEW FACILITIES (PHASE – 1)			
UNIT NO	DESCRITION	SIZE	QTY.
11B	NEW PANEL ROOM FOR DCS	19.5Mx21.50M	1
13B	NEW ELECTRICAL SUB STATION	83.0Mx24.50M	1
15B	NEW AIR COMPRESSOR	9.0Mx5.0M	1
17B	NEW CAPTIVE POWER PLANT	85.0Mx45.0M	1
20B	AMBIENT AIR HEATERS	33.0Mx75.0M	1+2
26B	NEW SHELL & TUBE VAPOURIZER	91.0Mx30.0M	1
27B	NEW HP LNG PUMP HOUSE	58.0Mx30.0M	1
28B	METERING YARD	31.2Mx44.0M	1
31B	LNG STORAGE TANK (180,000 CUM CAPACITY EACH)	ø82x36.54(H)	2
39B	GLYCOL WATER DRAIN SUMP	5.0Mx7.5M	1
40B	IMPOUNDING BASIN	6.0Mx6.0M	1
45B	HOT OIL STORAGE TANK & PUMP AREA	11.0Mx16.0M	1

KEY PLAN



TOTAL AREA –128.49 ACRES

NOTES:

1. ALL COORDINATES & DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE.
2. PLANT CO–ORDINATES SHOWN AS N +000.00 AND E +000.00 REPRESENTS GLOBAL CO–ORDINATES N +1468875.116 AND E +428450.722
3. HIGH POINT OF PAVING ELEVATION +100.000 METERS ID EQUAL TO 4.350 METERS ABOVE ABOVE MEAN SEA LEVEL OR 5M FROM CHART DATUM.
4. ALL DIMENSIONS ARE IN METER AS GRID LINE OF 50 M.
5. NEW FACILITY/EQUIPMENT ARE DENOTED AS SAME UNIT NO. WITH SUFFIX B
6. EPC CONTRACTOR TO VERIFY COORDINATE OF UNIT AS MENTIONED BEFORE ACTUAL WORK.
7. EPC CONTRACTOR SHALL VERIFY THE EXISTING FOUNDATION & UNDERGROUND LAYOUTS FOR INTERFERENCES.
8. EXISTING INSTRUMENT CABLE TRENCH TO BE VERIFIED BEFORE DETAILS DESIGN.

HOLD:

1. 4–POLES STRUCTURE

EXISTING FACILITIES (PHASE – 0)			
S.NO:	DESCRITION	SIZE	QTY.
1	SECURITY CABIN (LNG TRUCK ENTRY GATE 12M WIDE)	4.2Mx3.3M	1
2	MAIN SECURITY BUILDING	32Mx12M	1
3	ADMIN BUILDING –1 (2 STOREY BUILDING)	30.8Mx24.8M	1
4	ADMIN BUILDING –2	38Mx28.1M	1
5	CANTEEN/AMENITY BUILDING	25.7Mx18.3M	1
6	FIRST AID /OPERATIONAL HEALTH CENTER ROOM	14.3Mx10.2M	1
7	PLANT FIRE STATION BUILDING	17.8Mx17.9M	1
8	STORE	21.2Mx50.0M	1
9	WORKSHOP BUILDING	21.2Mx50.0M	1
10	LABORATORY	12.3Mx14.5M	1
11	CONTROL ROOM	19.2Mx55.2M	1
12	PIPE LINE DESPATCH STATION	16Mx22M	1
13	ELECTRICAL SUBSTATION	80Mx19M	1
14	NITROGEN STORAGE 30KL CAP./ N2 PACKAGE	31Mx20M	1
15	AIR COMPRESSOR HOUSE (3 NOS. OF COMPRESSOR)	40.8Mx26M	1
16	HSD STORAGE INSTALLATION (40KL)	32.4Mx15M	1
17	CAPTIVE POWER PLANT(3 NOS. GEG–9.36 MW EACH)	72Mx44M	1
18	D.G SETS (1000 KVA)	28Mx6.0M	1
18A	PROPOSED D.G SET (750 KVA)	28Mx6.0M	1
19	DAY TANK	900LTS	1
19A	DAY TANK	900LTS	1
20	AMBIENT AIR HEATERS (TOTAL–88 FANS) (2x32FANS & 1x24 FANS)	33Mx75M	3
21	FORCED DRAFT AIR VAPOURISER (30 NOS)	17.8x46.6M	2
22	FIRE WATER POND (58Mx62Mx2Mx4 NOS.),(157Mx22Mx2Mx1 NO.)	31348 CUM	5
23	FLARE STACK	60M HIGH	1
24	MSO COMPRESSOR ROOM (1NO. COMPRSSOR)	35Mx17M	1
25	BOG COMPRESSOR ROOM (3NOS. OF COMPRESSORS)	33Mx17M	1
26	SHELL & TUBE VAPOURISER UNIT (6 NOS. OF STV UNITS)	91Mx30M	1
27	HP LNG PUMP HOUSE (5 NOS. OF PUMPS)	58Mx30M	1
28	METERING YARD	22.6Mx16.4M	1
29	PIPELINE DESPATCH METERING YARD	44Mx19.2M	1
30	TANK LORRY FILLING STATION (LOADING BAYS–2NOS)	15Mx 16M	1
30A	TANK LORRY FILLING STATION (LOADING BAYS–2 NOS.)	15Mx20M	1
31	LNG STORAGE TANK (180,000 CUM CAPACITY EACH)	ø82x36.54(H)	2
32	RAIN WATER HARVESTING POND	40Mx30M	2
33	UTILITY WATER TANK	15MX4M	1
34	COOLING WATER TOWER	2.4x2.5M	1
35	WATER TREAMENT SKID	13Mx4M	1
36	SECURITY CABIN (JETTY GATE)	–	1
37	TWO WHEELER PARKING SHED	20Mx7M	1
38	LABOUR REST ROOM	17.5Mx7.5M	1
39	GLYCOL WATER DRAIN SUMP	5.0Mx7.5M	1
40	IMPOUNDING BASIN	6.0Mx6.0M	1
41	DIESEL DAY TANK 900 LTS. (FOR FIRE PUMPS)	2.0Mx1.3M	5
42	FIRE PUMP HOUSE (DIESEL PUMP –5NOS. , ELEC. PUMP – 4 NOS.JOCKEY PUMPS –2NOS.	33Mx26.0M	1 1
43	WEIGHT BRIDGE FOR ROAD TANKER	4.0Mx26.0M	1
44	WEIGHT BRIDGE CABIN	4.5Mx6.0M	1

LEGEND :

OUTER BOUNDARY WALL (3M HEIGHT)
INNER CHAIN LINK FENCING (1.8M HEIGHT)
EXISTING
NEW PIPE RACK
NEW

S.NO.	REFERENCE DRAWING	DRAWING NO.
B	19200-0102-8310-45-0227	UNDER GROUND UTILITIES - SITE COMPOSITE PLAN
A	19200-01920-0102-8230-01-0201	PLAN SHOWING LNG IMPORT, STORAGE, RE-GASIFICATION TERMINAL(AS BUILT)

REV.	DATE	DESCRIPTION	DWN. BY	CHK. BY	APPD. BY
0	26-09-2022	ISSUED FOR TENDER	KDD	PG	SK
A	06-09-2022	ISSUED FOR REVIEW	KDD	PG	SK

LOCATION : ENNORE , TAMILNADU , INDIA

PROJECT : FEED FOR EXPANSION OF EXISTING 5 MMTPA CAPACITY TO 10 MMTPA CAPACITY OF ENNORE LNG TERMINAL.

FEED CONSULTANT : RINA Consulting S.p.A.

CLIENT : IndianOil LNG Pvt. Ltd.

TITLE :

PLOT PLAN

SCALE : 1 : 1500 | DRAWING NO : 31844-00-PI-PLT-008 | SHEET NO : 1 OF 1 | REV. : 0

CONTRACT NO : IOLPL / 2022-23 / EXPANSION / FEED | SHEET : A0

ANNEXURE- V

RAPID RISK ANALYSIS STUDY

RAPID RISK ANALYSIS STUDY

OF

LNG IMPORT, STORAGE & REGASIFICATION TERMINAL, ENNORE

IndianOil LNG Pvt Ltd

Rev No	Date	Purpose	Prepared By	Reviewed By	Approved By
2	31.01.2023	Issued for Comments	PK	AMP	DK
1	06.01.2023	Issued for Comments	PK	AMP	DK
0	04.08.2022	Issued for Comments	PK	AMP	AMP
A	10.06.2022	Issued for Comments	PK	AMP	AMP

PREFACE

M/s Engineers India Limited (EIL) has been appointed by M/s IndianOil LNG for undertaking the Rapid Risk Analysis study of the LNG Import, Storage & Regasification Terminal at Ennore, Chennai, Tamilnadu.

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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ANNEXURE-II: FIGURES FOR CONSEQUENCE ANALYSIS
ANNEXURE-III: LNG TERMINAL PLOT PLAN

1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

IndianOil LNG Private Limited (IOLPL), a Joint Venture Company of Indian Oil Corporation Ltd. (IndianOil) as the Promoter with 45% shareholding, is operating5 MMTPA capacity LNG Terminal inside Kamarajar Port at Ennore, Chennai,Tamilnadu. The gas demand in the Ennore catchment area expected to increase more than 5 MMTPA in 2025-26. IOLPL proposes to augment the capacity of existing Ennore LNG Terminal from 5 MMTPA to 10MMTPA.

This executive summary covers major findings arising out of the Rapid Risk Analysis study and recommendations for the safe operation. The detailed analysis is given in Section –6.

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) and cases with low chance of occurrence but having high consequence, e.g., Catastrophic Rupture of Loading Arm. Effect zones for various outcomes of failure scenarios (Flash Fire, Jet Fire, Pool Fire, Blast overpressure, 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 FINDINGS AND 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 major findings and recommendations based on maximum effect zone distance from risk analysis are summarized below:

a) **Instrument Tapping Failure (20mm leak) at Discharge of Intank LP Pump (Refer Annexure-II, Figures 1.1.1 to 1.1.2):** From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m at the height of 42 m and not reaching to ground. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9

kW/$m^2$and 5 kW/m^2 not realized at grade level. The 3 and 1 psi blast wave overpressure is realized up to 42&58 m respectively from the source point and have impact on new LNG Storage Tank.

Based on the above following is recommended:

- Provide sufficient number of hydrocarbon detectors near new LP LNG Pump for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.

b) Instrument Tapping Failure (20mm leak) at High Pressure LNG Pump Discharge (Refer Annexure-II, Figures 2.1.1 to 2.1.3) : From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~82 m. LFL hazardous zone is covering the road on the eastern, western& northern side of the HP Pumps, part of LNG Storage tanks, part of STV area, metering yard and part of existing HP LNG Pump House. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 63, 65, 78 & 87 m. Radiation intensity of 30 kW/m^2, 25 kW/m^2 covering road on western, northern & eastern side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area & part of pipeline dispatch area and 9 kW/m^2 and 5 kW/$m^2$is covering road on northern, eastern& western side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area of High Pressure LNG Pumps, part of LNG Storage Tanks. The 3 and 1 psi blast wave overpressure effect distances is realized up to102 &131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area ,LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the eastern, western and northern side of the HP Pumps through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- The Existing Control Room is being affected due to blast overpressure generated from proposed new HP LNG pump instrument tapping failure so same needs to be revalidated through QRA to be carried out during detail engineering and accordingly suitable mitigation measure shall be adopted during detail engineering.

- Provide sufficient number of hydrocarbon detectors within the new HP LNG Pump House for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.
- Roads on northern, eastern & western side of the HP LNG Pumps are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

c) **Flange Leakage (10mm leak) at High Pressure LNG Pump Discharge (Refer Annexure-II, Figures 2.2.1 to 2.2.3):**From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m. LFL hazardous zone is covering the road on the eastern side of the HP Pumps. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2 , 9 kW/m^2 and 5 kW/m^2 is realized up to 34, 35, 42 & 47 m and covering road on eastern side of the high Pressure LNG Pump, pipe Rack on western& northern side of the HP LNG Pump, part of STV Area. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41& 55 m respectively from the source point and covering the LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the eastern side of the HP Pumps through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Provide sufficient number of hydrocarbon detectors within the new HP LNG Pump House for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.
- Roads on eastern side of the HP LNG Pumps is getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

d) **Flange Joint Leak (10mm leak) at Shell & Tube Vaporiser Inlet (Refer Annexure-II, Figures 3.1.1 to 3.1.3):**From the consequence analysis, it was observed that LFL is realized up to a distance of ~32 m. The LFL hazardous zone is covering some part of the road on western side of the STV. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 34, 35, 42 & 47 and covering the Pipe Rack on the eastern side &

Road on the western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41&55 m respectively from the source point and covering HP LNG Pumps, New & Existing Metering Yard, Existing STV Unit and LNG Storage Tanks (new/existing).

Based on the above following is recommended:

- Restrict vehicle movements on the road on the western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on western side of the STV are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

e) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Inlet (Refer Annexure-II, Figures 3.2.1 to 3.2.3) :

From the consequence analysis, it was observed that LFL is realized up to a distance of ~82 m. The LFL hazardous zone is covering some part of the road on northern &western side of the STV. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 63, 65, 78 & 87 and covering the Pipe Rack on the eastern side & Road on the northern, eastern & western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 102&131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area, LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room, part of electrical substation.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the northern &western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on northern, eastern &western side of the STV are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- The Existing Control Room is being affected due to blast overpressure generated from proposed new STV instrument tapping failure so same needs to be revalidated through QRA to be carried out during detail engineering and accordingly suitable mitigation measure shall be adopted during detail engineering.
- Ensure that there is minimum permanent occupancy in the electrical substation.

f) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Outlet (Refer Annexure-II, Figures 4.2.1 to 4.2.3) :

From the consequence analysis, it was observed that LFL is realized up to a distance of ~17 m at height of 1m. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 25, 27, 33 & 37 and covering pipe rack on eastern side & road on western side. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16 &24 m respectively from the source point.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.

g) 10mm leak at Loading Arms(near Gantry Area)(Refer Annexure-II, Figures 5.1.1 to 5.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~38 m and covering the road on the northern & southern side of the Loading Arm. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 25, 25, 29 & 33 and covering the road on northern & southern side of Loading Arm & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41&56 m respectively from the source point and covering road, Pipe Rack on southern side of Loading Arm.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the northern & southern side of the Loading Arm through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on southern side of the Loading Arm are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- Provide sufficient number of hydrocarbon detectors near Loading Arm area for early leak detection and develop procedures to stop loading & inventory isolation and for safe evacuation of personnel in case of loss of containment.

h) Loading Arms Rupture (~75 mm) (Refer Annexure-II, Figures 6.1.1 to 6.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~108 m and covering the road on the northern & southern side of the Loading Arm and part of new LNG

Storage area. The jet fire radiation intensity of 30kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 47, 48, 59 & 67 and covering the road in northern & southern side & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 137&185 m respectively from the source point and covering road inside facility , Pipe Rack & part of existing LNG Storage Tank & new LNG Storage Tank on southern side of Loading Arm.

Based on the above following is recommended

- This scenario shall be considered in formulating disaster management plan of the LNG Terminal as it is low failure frequency scenario

i) **Instrument Tapping Failure (20mm leak) at Metering Yard (Refer Annexure-II, Figures 7.1.1 to 7.1.3):** From the consequence analysis, it was observed that LFL is realized up to a distance of ~17m, it is not realized at grade. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 25, 27, 33 & 37 and covering the road in the eastern, western& northern side of the Metering Yard. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16&24 m respectively from the source point and covering part of STV area.

Based on the above following is recommended:

- Roads on eastern, western & northern side of the Metering Yard are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

j) **Instrument Tapping Failure (20mm leak) at Hot Oil Pump Discharge (Refer Annexure-II, Figures 8.1.1 to 8.1.4):** From the consequence analysis, it was observed that LFL is realized up to a distance of ~37 m and covering the road on the northern, eastern & western side of the Hot Oil Pump and N2 Package Area, Substation Building and CPP Area. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 25, 26, 32 & 38 and covering the road on eastern, northern & western side Hot Oil Pump and Substation Building and CPP Area. The pool fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 36, 40, 62&77 and covering the road on eastern, western and northern side, substation building, CPP, proposed air compressor, air compressor house and Cooling water tower. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41 & 55 m respectively from the source point and covering Substation Building.

Based on the above following is recommended:

- Restrict vehicle movements on the road on northern, eastern & western side of the Hot Oil Pump through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on eastern, western & northern side of the Hot Oil Pump are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- Substation Building is getting affected due to jet fire , it is recommended to keep the entry and exit to the building outside the effect zone of jet fire thermal radiation intensity of 25 KW/m2for safe entry & exit to the building.
- Permanent occupancy level in the SS shall be decided based on QRA to be carried out during detail engineering.
- Ensure that the entry & exit to the substation building are outside the effect zone of pool fire thermal radiation intensity of 25 KW/m2.
- Ensure that inlet of fresh air intake of the substation building (on the eastern side of the hot oil facility) shall be opposite side of Hot oil facility with adequate numbers of detectors (HC) in the inlet fresh air duct of HVAC for detecting flammable vapors and actuating interlock for closing air damper in fresh air duct.

2 INTRODCUTION

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 facility
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. 8.4 developed by DNV Technica.

2.2 SCOPE OF WORK

The study addresses the hazards that can be realized due to operations associated with the proposed LNG Terminal capacity expansion project from 5 MMTPA to 10MMTPA.

3 SITE CONDITION

3.1 GENERAL

This chapter describes the location of LNG Terminal, Ennore, TN and meteorological data, which have been used for the Rapid Risk Analysis study.

3.2 SITE, LOCATION AND VICINITY

Figure 1: LNG Terminal, Ennore

3.3 METEOROLOGICAL CONDITIONS

The consequences of released flammable material are largely dependent on the prevailing weather conditions. For the assessment of major scenarios involving release of 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 Chennai Nungambakkam weather station(Which is nearest weather station from project facility)has 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 (^{O}C)	29
2.	Atmospheric Pressure (mm Hg)	760
3.	Relative Humidity (%)	0.72
4.	Solar Radiation flux (kW/m^2)	0.46

Wind Speed and Wind Direction

The meteorological data considered for the study is based on the Chennai Nungambakkam weather station datafrom the IMD Table. Based on the Meteorological data provided in IMD table, it is observed that average wind speed of magnitude of around 1.5-2 m/s blows for around 90% of the time, in a year. Hence predominant wind speeds for terminalconsidered for RRA Study are1.5&2 m/s.

Table 2: Average Mean Wind Speed (m/s)

Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1.5	1.4	1.5	1.8	2.1	2.2	1.9	1.9	1.6	1.3	1.6	1.8

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 insulation) and nighttime sky cover have been identified as prime factors defining these stability categories. Below Table indicates the various Pasquill stability classes.

Table 3: Pasquill Stability Classes

Surface Wind Speed (meter/s)	Insolation			Night		
	Strong	Moderate	Slight	Thinly overcast or > 4/8 low cloud	<= 4/8 cloud	
< 2	A	A – B	B	E	F	
2 – 3	A – B	B	C	E	F	
3 – 5	B	B – C	C	D	E	
5 – 6	C	C – D	D	D	D	
> 6	C	D	D	D	D	

Source: PHAST Manual

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, solar radiation and wind speed. For risk analysis, the representative average annual weather conditions are assessed based on the following:

Average Wind speed in order of 1.5-2 m/s would be experienced for around90% of time in a year. Based on weather analysis, predominant weather stability of “F”, “A” and “E” was selected with wind speed 1.5 m/s&2 m/s for consequence analysis, respectively.

The consequence results are reported in tabular form for all the weather conditions and are represented graphically for worst weather condition.

Table 4: Weather Conditions

Wind Speed	Pasquill Stability
1.5	A
1.5	F
2	E

Note: For RRA Study Plot Plan (Doc. No.: 19200-0102-8230-01-0201 Rev Z7) has been used.
LNG Terminal plot plan is attached as **"Annexure-III".**

4 HAZARDS ASSOCIATED WITH THE FACILITIES

4.1 GENERAL

LNG Terminal handles the Natural Gas which has a potential to cause fire and explosion hazards. This chapter describes in brief the hazards associated with Natural Gas.

4.2 HAZARDS ASSOCIATED WITH FLAMMABLE MATERIALS

4.2.1 LIQUEFIED NATURAL GAS

Liquid Natural Gas (LNG) is primarily methane that is liquefied at -165 deg. C to reduce its volume 600 to 1. It is colorless & odorless (it does not exhibit the characteristics odor of Natural Gas)

The main hazards in handling LNG are fire and explosion, cryogenic freeze burns, embrittlement of metals and plastics, and confined spaces hazards

LNG vapors are extremely flammable and explosive; avoid heat, sparks, open flames, and all possible sources of ignition. Heat will increase pressure in the storage tank. When its vapors mix with appropriate amounts of oxidizing agents, including air and oxygen, in the presence of an ignition source, an uncontrolled explosive reaction can occur.

Contact with the liquefied or pressurized gas may cause eye damage, swelling & skin frostbite.

4.2.2 NATURAL GAS

The highly flammable nature makes gaseous hydrocarbons the most hazardous of petroleum products. When a gaseous hydrocarbon is released on account of a mechanical failure, depending upon its vapour density and the prevalent weather conditions, it will either form a vapour cloud or disperse without giving cause for further concern. Substantial mixing with air occurs immediately after the release, though the extent of such mixing depends upon particular meteorological conditions including the temperature and turbulence of the air.

The flammable cloud formed by natural gas is normally lighter than air and, given stable weather conditions, forms a thin layer some distance above the ground, whose movement is influenced even by slight breezes in the area of the release. As it spreads, were it to encounter a source of ignition, it would constitute a flash fire, spreading over the area covered by the cloud. However, since the cloud gets diluted with air as it spreads, the likelihood of a flash fire is greatest in the regions where the concentration of the material lies between the lower and upper flammability limits. Nevertheless, releases of greater volume require greater distances to be safely diluted below the LFL. It would also be worthwhile to observe that distances beyond the LFL limit could

also be affected, if the cloud were to undergo a substantial volumetric expansion, on account of the fire.

Clouds of gas may constitute a "Fireball", under appropriate conditions. A fireball is a spherical cloud of flammable material burning with great turbulence and rising as it mixes with the surrounding air; combustion of the entire mass is generally completed within seconds. While the radiation from a fireball is very intense and can cause a great deal of damage, the risk of occurrence of a fireball is particularly serious only when there is a possibility of the immediate ignition of a large mass of fuel released rapidly.

If the gas is released under sufficient pressure to constitute a continuous stream, a jet fire may ensue. The flames of a jet fire are normally of greater intensity near the source and rapidly peter out farther away. While the flame is normally in the direction of the jet, the wind can bend the flame.

In certain cases, a flame may spread rapidly, from the point of ignition, through a vapour cloud with complete combustion occurring within seconds. While the radiation intensity is always severe, if the flame-front travels fast enough through the cloud, the surrounding air will be compressed to such an extent, on account of the expansion of the burning gas cloud, as to create overpressure or "blast" effects, thus constituting an unconfined vapour cloud explosion (UVCE). Many of the most severe industrial accidents have been associated with such UVCEs

In case the released material remains un-ignited, until its dispersal and dilution below its Lower Flammability Limit, it causes little damage except for asphyxiation of personnel in the immediate vicinity of release, on account of the very high concentrations prevalent there.

Table 5: Hazardous Properties of NG

Sl. No.	Properties	Values
1.	LFL (%v/v)	4.21
2.	UFL (%v/v)	16
3.	Auto ignition temperature (°C)	537(methane)
4.	Heat of combustion (KJ/Kg)	4.96E7
5.	Normal Boiling point (°C)	-160
6.	Flash point (°C)	-176

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.

- Catastrophic Rupture of Loading Arm
- Large hole on outlet of process vessel
- “Guillotine-Breakage” of pipe-work
- Small hole, cracks or small bore failure (i.e. instrument tapping failure, drains/vents failure etc.) in piping and vessels.
- Flange leaks.
- Storage Tank on fire
- Leaks from pump glands and similar seals.

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 two-bolt gasket leak for flanges, seal failure for pumps, instrument

tapping failure, 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 Rupture of Loading Arm, 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 facility. 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.

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 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 below[1].

Table 6: Size of Release

Failure Description	Leak Size
Flange gasket failure	10 mm hole size
Instrument tapping failure	20 mm hole size
Loading Arm Rupture	75 mm, complete rupture of 3” line to be updated in line with leak size considered in model

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 leak[2].

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 exposition are discussed.

[1] Refer to Guideline for Quantitative Risk assessment ‘Purple Book’.
[2] Release duration is based on Chemical Process Quantitative Risk Analysis, CCPS.

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 7: Damage Due to Incident Thermal Radiation Intensity as per NFPA 59A

Incident Radiation Intensity (kW/m^2)	Type of Damage
30	Irreversible harm to and fatality of persons inside a building with a noncombustion exterior.
25	Irreversible harm to and fatality of persons inside a building with a combustion exterior.
9	Fatality of persons outdoors without personal protective equipment (PPE)
5	Irreversible harm to persons outdoors without PPE.

The hazard distances to the 30 kW/m^2, 25 kW/m^2,9 kW/m^2& 5 kw/m^2radiation 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 8: Damage Effects of Blast Overpressure as per NFPA 59A

Blast Overpressure (psi)	Damage Level
5.0	Major structure damage
3.0	Fatality of persons outdoors
1.0	Irreversible harm of persons outdoors

The hazard distances to the 5 psi, 3 psi and 1 psi overpressure levels, selected based on their effects on population; buildings and equipment were modeled using PHAST.

6.5 CONSEQUENCEANALYSISFORUNITS

This section discusses the consequences of selected failure scenarios for various units. 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 a unit for worst weather conditions.

Instrument Tapping Failure (20mm leak) at Discharge of Intank LP Pump (Refer Annexure-II, Figures 1.1.1& 1.1.2): From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m at the height of 42 m and not reaching to ground. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 not realized at grade level. The 3 and 1 psi blast wave overpressure is realized up to 42&58 m respectively from the source point and have impact on new LNG Storage Tank.

Flange Leakage (10mm leak) at Discharge of Intank LP Pump (Refer Annexure-II, Figures 1.2.1 & 1.2.2): From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~19 m at the height of 42 m. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 not realized at grade level. The 3 and 1 psi blast wave overpressure is realized up to 16 & 25 m respectively from the source point and have no major impact on nearby facilities.

Instrument Tapping Failure (20mm leak) at High Pressure LNG Pump Discharge (Refer Annexure-II, Figures 2.1.1 to 2.1.3) : From the consequence analysisof the selected failure scenario, it was observed that LFL may spread up to a distance of ~82 m. LFL hazardous zone is covering the road on the eastern, western & northern side of the HP Pumps, part of LNG Storage tanks, part of STV area, metering yard and part of existing HP LNG Pump House. The jet fire

radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 63, 65, 78 & 87 m. Radiation intensity of 30 kW/m^2, 25 kW/m^2 covering road on western, northern & eastern side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area & part of pipeline dispatch area and 9 kW/m^2 and 5 kW/$m^2$is covering road on northern, eastern & western side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area of High Pressure LNG Pumps, part of LNG Storage Tanks. The 3 and 1 psi blast wave overpressure effect distances is realized up to 102 &131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area , LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Flange Leakage (10mm leak) at High Pressure LNG Pump Discharge (Refer Annexure-II, Figures 2.2.1 to 2.2.3) : From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m. LFL hazardous zone is covering the road on the eastern side of the HP Pumps. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2 , 9 kW/m^2 and 5 kW/m^2 is realized up to 34, 35, 42 & 47 m and covering road on eastern side of the high Pressure LNG Pump, pipe Rack on western& northern side of the HP LNG Pump, part of STV Area. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41& 55 m respectively from the source point and covering the LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Flange Joint Leak (10mm leak) at Shell & Tube Vaporiser Inlet (Refer Annexure-II, Figures 3.1.1 to 3.1.3) : From the consequence analysis, it was observed that LFL is realized up to a distance of ~32 m. The LFL hazardous zone is covering some part of the road on western side of the STV. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 34, 35, 42 & 47 and covering the Pipe Rack on the eastern side & Road on the western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41&55 m respectively from the source point and covering HP LNG Pumps, New & Existing Metering Yard, Existing STV Unit and LNG Storage Tanks (new/existing).

Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Inlet (Refer Annexure-II, Figures 3.2.1 to 3.2.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~82 m. The LFL hazardous zone is covering some part of the road on northern &western side of the STV. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 63, 65, 78 & 87 and covering the Pipe Rack on the eastern side & Road on the northern, eastern & western side of STV. The 3 and 1 psi blast wave overpressure effect

distances is realized up to 102&131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area, LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room, part of electrical substation.

Flange Joint Leak (10mm leak) at Shell & Tube Vaporiser Outlet (Refer Annexure-II, Figures 4.1.1 to 4.1.3) : From the consequence analysis, it was observed that LFL is realized up to a distance of ~8 m at height of 1m. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 13, 13, 16 & 18.

Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Outlet (Refer Annexure-II, Figures 4.2.1 to 4.2.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~17 m at height of 1m. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 25, 27, 33 & 37 and covering pipe rack on eastern side & road on western side. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16 &24 m respectively from the source point.

10mm leak at Loading Arms (Refer Annexure-II, Figures 5.1.1 to 5.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~38 m and covering the road on the northern & southern side of the Loading Arm. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 25, 25, 29 & 33 and covering the road on northern & southern side of Loading Arm & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41 &56 m respectively from the source point and covering road, Pipe Rack on southern side of Loading Arm.

Loading Arms Rupture (Refer Annexure-II, Figures 6.1.1 to 6.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~108 m and covering the road on the northern & southern side of the Loading Arm and part of new LNG Storage area. The jet fire radiation intensity of 30kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 47, 48, 59 & 67 and covering the road in northern & southern side & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 137 &185 m respectively from the source point and covering road inside facility , Pipe Rack & part of existing LNG Storage Tank & new LNG Storage Tank on southern side of Loading Arm.

Instrument Tapping Failure (20mm leak) at Metering Yard Loading Arms Rupture (Refer Annexure-II, Figures 7.1.1 to 7.1.3):): From the consequence analysis, it was observed that LFL is realized up to a distance of ~17m, it is not realized at grade. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 25, 27, 33 & 37 and covering the road in the eastern, western& northern side of the Metering Yard. The 3 and 1 psi blast wave

overpressure effect distances is realized up to 16 &24 m respectively from the source point and covering part of STV area.

Instrument Tapping Failure (20mm leak) at Hot Oil Pump Discharge (Refer Annexure-II, Figures 8.1.1 to 8.1.4): From the consequence analysis, it was observed that LFL is realized up to a distance of ~37 m and covering the road on the northern, eastern & western side of the Hot Oil Pump and N2 Package Area, Substation Building and CPP Area. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 25, 26, 32 & 38 and covering the road on eastern, northern & western side Hot Oil Pump and Substation Building and CPP Area. The pool fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 36, 40, 62&77 and covering the road on eastern, western and northern side, substation building, CPP, proposed air compressor, air compressor house and Cooling water tower. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41 & 55 m respectively from the source point and covering Substation Building.

Hot Oil Storage Tank on Fire: The pool fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 10, 12, 21 & 27 m.

7 MAJOR FINDINGS& 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 major findings and recommendations based on maximum effect zone distance from risk analysis are summarized below:

a) **Instrument Tapping Failure (20mm leak) at Discharge of Intank LP Pump (Refer Annexure-II, Figures 1.1.1 to 1.1.3):** From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m at the height of 42 m and not reaching to ground. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 not realized at grade level. The 3 and 1 psi blast wave overpressure is realized up to 42&58 m respectively from the source point and have impact on new LNG Storage Tank.

Based on the above following is recommended:

- Provide sufficient number of hydrocarbon detectors near new LP LNG Pump for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.

b) **Instrument Tapping Failure (20mm leak) at High Pressure LNG Pump Discharge (Refer Annexure-II, Figures 2.1.1 to 2.1.3) :** From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~82 m. LFL hazardous zone is covering the road on the eastern, western & northern side of the HP Pumps, part of LNG Storage tanks, part of STV area, metering yard and part of existing HP LNG Pump House. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 63, 65, 78 & 87 m. Radiation intensity of 30 kW/m^2, 25 kW/m^2 covering road on western, northern & eastern side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area & part of pipeline dispatch area and 9 kW/m^2 and 5 kW/$m^2$is covering road on northern, eastern & western side of the high Pressure LNG Pump, pipe Rack on western & northern side of the HP LNG Pump, part of Metering Skid, part of STV Area of High Pressure LNG Pumps, part of LNG Storage Tanks. The 3 and 1 psi blast wave overpressure effect distances is realized up to 102 &131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area , LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the eastern, western and northern side of the HP Pumps through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- The Existing Control Room is being affected due to blast overpressure generated from proposed new HP LNG pump instrument tapping failure so same needs to be revalidated through QRA to be carried out during detail engineering and accordingly suitable mitigation measure shall be adopted during detail engineering.
- Provide sufficient number of hydrocarbon detectors within the new HP LNG Pump House for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.
- Roads on northern, eastern & western side of the HP LNG Pumps are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

c) Flange Leakage (10mm leak) at High Pressure LNG Pump Discharge (Refer Annexure-II, Figures 2.2.1 to 2.2.3): From the consequence analysis of the selected failure scenario, it was observed that LFL may spread up to a distance of ~32 m. LFL hazardous zone is covering the road on the eastern side of the HP Pumps. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2 , 9 kW/m^2 and 5 kW/m^2 is realized up to 34, 35, 42 & 47 m and covering road on eastern side of the high Pressure LNG Pump, pipe Rack on western& northern side of the HP LNG Pump, part of STV Area. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41& 55 m respectively from the source point and covering the LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the eastern side of the HP Pumps through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Provide sufficient number of hydrocarbon detectors within the new HP LNG Pump House for early leak detection and develop procedures to stop rotating equipment & inventory isolation and for safe evacuation of personnel in case of loss of containment.

- Roads on eastern side of the HP LNG Pumps is getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

d) Flange Joint Leak (10mm leak) at Shell & Tube Vaporiser Inlet (Refer Annexure-II, Figures 3.1.1 to 3.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~32 m. The LFL hazardous zone is covering some part of the road on western side of the STV. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 34, 35, 42 & 47 and covering the Pipe Rack on the eastern side & Road on the western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41&55 m respectively from the source point and covering HP LNG Pumps, New & Existing Metering Yard, Existing STV Unit and LNG Storage Tanks (new/existing).

Based on the above following is recommended:

- Restrict vehicle movements on the road on the western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on western side of the STV are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

e) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Inlet (Refer Annexure-II, Figures 3.2.1 to 3.2.3) :

From the consequence analysis, it was observed that LFL is realized up to a distance of ~82 m. The LFL hazardous zone is covering some part of the road on northern &western side of the STV. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 63, 65, 78 & 87 and covering the Pipe Rack on the eastern side & Road on the northern, eastern & western side of STV. The 3 and 1 psi blast wave overpressure effect distances is realized up to 102&131 m respectively from the source point and covering the Control Room, Pipeline Dispatch Station Area, LNG Storage Tanks (new/existing), existing HP Pump House, Shell & Tube Vaporiser Unit, part of BOG Compressor Room, part of electrical substation.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the northern &western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.

- Roads on northern, eastern &western side of the STV are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- The Existing Control Room is being affected due to blast overpressure generated from proposed new STV instrument tapping failure so same needs to be revalidated through QRA to be carried out during detail engineering and accordingly suitable mitigation measure shall be adopted during detail engineering.
- Ensure that there is minimum permanent occupancy in the electrical substation.

f) Instrument Tapping Failure (20mm leak) at Shell & Tube Vaporiser Outlet (Refer Annexure-II, Figures 4.2.1 to 4.2.3) :

From the consequence analysis, it was observed that LFL is realized up to a distance of ~17 m at height of 1m. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 25, 27, 33 & 37 and covering pipe rack on eastern side & road on western side. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16 &24 m respectively from the source point.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the western side of the STV through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.

g) 10mm leak at Loading Arms (near Gantry Area) (Refer Annexure-II, Figures 5.1.1 to 5.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~38 m and covering the road on the northern & southern side of the Loading Arm. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 25, 25, 29 & 33 and covering the road on northern & southern side of Loading Arm & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41 &56 m respectively from the source point and covering road, Pipe Rack on southern side of Loading Arm.

Based on the above following is recommended:

- Restrict vehicle movements on the road on the northern & southern side of the Loading Arm through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.

- Roads on southern side of the Loading Arm are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- Provide sufficient number of hydrocarbon detectors near Loading Arm area for early leak detection and develop procedures to stop loading & inventory isolation and for safe evacuation of personnel in case of loss of containment.

h) Loading Arms Rupture (~75 mm) (Refer Annexure-II, Figures 6.1.1 to 6.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~108 m and covering the road on the northern & southern side of the Loading Arm and part of new LNG Storage area. The jet fire radiation intensity of 30kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 47, 48, 59 & 67 and covering the road in northern & southern side & Pipe Rack on southern side of Loading Arm. The 3 and 1 psi blast wave overpressure effect distances is realized up to 137 &185 m respectively from the source point and covering road inside facility , Pipe Rack & part of existing LNG Storage Tank & new LNG Storage Tank on southern side of Loading Arm.

Based on the above following is recommended

- This scenario shall be considered in formulating disaster management plan of the LNG Terminal as it is low failure frequency scenario

i) Instrument Tapping Failure (20mm leak) at Metering Yard (Refer Annexure-II, Figures 7.1.1 to 7.1.3): From the consequence analysis, it was observed that LFL is realized up to a distance of ~17m, it is not realized at grade. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/$m^2$is realized up to 25, 27, 33 & 37 and covering the road in the eastern, western& northern side of the Metering Yard. The 3 and 1 psi blast wave overpressure effect distances is realized up to 16 &24 m respectively from the source point and covering part of STV area.

Based on the above following is recommended:

- Roads on eastern, western & northern side of the Metering Yard are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.

j) Instrument Tapping Failure (20mm leak) at Hot Oil Pump Discharge (Refer Annexure-II, Figures 9.1.1 to 9.1.4): From the consequence analysis, it was observed that LFL is realized up to a distance of ~37 m and covering the road on the northern, eastern & western side of the Hot Oil Pump and N2 Package Area, Substation Building and CPP Area. The jet fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 25, 26, 32 & 38 and covering the road on eastern, northern & western side Hot Oil Pump and Substation Building and CPP Area.The pool fire radiation intensity of 30 kW/m^2, 25 kW/m^2, 9 kW/m^2 and 5 kW/m^2 is realized up to 36, 40, 62&77 and covering the road on eastern, western and northern side, substation building, CPP, proposed air compressor, air compressor house and Cooling water tower. The 3 and 1 psi blast wave overpressure effect distances is realized up to 41 & 55 m respectively from the source point and covering Substation Building.

Based on the above following is recommended:

- Restrict vehicle movements on the road on northern, eastern & western side of the Hot Oil Pump through suitable means. Only emergency vehicles or authorized vehicles shall be allowed on this road.
- Roads on eastern, western & northern side of the Hot Oil Pump are getting affected due to Jet Fire radiation intensity of 5 kW/m2 which will impair these roads to be used as escape routes during this emergency so this scenario shall be covered in disaster management plan.
- Substation Building is getting affected due to jet fire, it is recommended to keep the entry and exit to the building outside the effect zone of jet fire thermal radiation intensity of 25 KW/m2for safe entry & exit to the building.
- Permanent occupancy level in the SS shall be decided based on QRA to be carried out during detail engineering.
- Ensure that the entry & exit to the substation building are outside the effect zone of pool fire thermal radiation intensity of 25 KW/m2.
- Ensure that inlet of fresh air intake of the substation building (on the eastern side of the hot oil facility) shall be opposite side of Hot oil facility with adequate numbers of detectors (HC) in the inlet fresh air duct of HVAC for detecting flammable vapors and actuating interlock for closing air damper in fresh air duct.

General Recommendations

- ✓ Low frequency failure scenarios such as Loading Arm rupture discussed in this report shall be considered in formulating disaster management plan of the LNG Terminal.

- ✓ To enable rapid detection of leak/ fire, HC (point or open path) gas and UV/IR Flame detectors shall be located in strategic location in the facility.
- ✓ In order to prevent secondary incident arising from any failure scenario, it is recommended that sprinklers and other protective devices provided on the tanks to be regularly checked to ensure that they are functional.
- ✓ 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.
- ✓ It shall be ensured that all the vehicles entering the plant shall be provided with spark arrestors at the exhaust.
- ✓ Employees and Truck drivers must be well trained and must be aware of the hazards involved in the loading operation.
- ✓ The critical operating steps shall be displayed on the board near the location where applicable.
- ✓ Loading operations shall be immediately suspended in the event of leak, a fire in the vicinity, lightning and thunder storm.
- ✓ Clearly marked escape routes shall be provided in the gantry for ease of escape.
- ✓ Mock drills to be organized at organization level to ensure preparation of the personnel's working in premises for handling any hazardous situation.
- ✓ Active fire protection system shall be provided throughout the facility for preventing escalation of fire.
- ✓ Recommended to use portable HC detector during sampling and maintenance etc.

i. 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, Flame etc.) and development of subsequent quick isolation mechanism.
- ✓ Measures for controlling / minimization of Ignition sources inside the operating area.
- ✓ Active and Passive Fire Protection for critical equipment's and major structures
- ✓ Effective Emergency Response plans to be in place

ii. 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 is strongly

recommended to consider minimization of the traffic movement in the vicinity of operating area.

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

iv. Preventive Maintenance for Critical Equipment's

- ✓ In order to reduce the failure frequency of critical equipment's, the following are recommended:

    a. High head pumps which are in flammable services, are needed to be identified.
        i. Their seals, instruments and accessories are to be monitored closely
        ii. A detailed preventive maintenance plan to be prepared and followed.

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
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.

9 REFERENCES

1. NFPA 59A, Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG).
2. Climatological Tables of Observatories in India (1981-2010)
3. Classification of hazardous locations, A. W. Cox, F. P. Lees and M. L. Ang, Published by the Institute of Chemical engineers, U. K.
4. The reference manual, Volume-II, Creemer& Warner Ltd. U. K. (Presently Entec).
5. Risk analysis of six potentially hazardous industrial objects in the Rijnmond area; A pilot study. A report to the Rijnmond Public Authority. D. Riedel publishing company, U. K.
6. Loss prevention in the process industries, Hazard identification, Assessment and Control, Frank. P. Lees (Vol. I, II & III), Published by Butterworth-Heinemann, U. K.
7. AICHE, CCPS, Chemical process Quantitative Risk Analysis
8. Guideline for Quantitative Risk assessment, 'Purple book'.

ANNEXURE-I

CONSEQUENCE ANALYSIS HAZARD DISTANCES

Consequence Analysis Hazard Distances

Unit / Facility	Sl. No.	Equipment	Failure Case	Operating Conditions		Leak Rate (Kg/s)	State Liquid /Gas	Weather Condition	LFL (m)	LFL Fraction (m)	Jet Fire (m)				Pool Fire (m)				Over Pressure (m)		
				Temp. (^{O}C)	Press. (Kg/cm^{2}g)						5 kW/m^2	9 kW/m^2	25 kW/m^2	30 kW/m^2	5 kW/m^2	9 kW/m^2	25 kW/m^2	30 kW/m^2	1 psi	3 psi	5 psi
LNG Terminal	1	In tank LP Pump discharge	Instrument Tapping Failure (20mm)	-165	10	5.50	Liq	1.5 /A	28	37	-	-	-	-	-	-	-	-	41	29	26
								1.5 / F	30	42	-	-	-	-	-	-	-	-	42	29	27
								2 / E	32	45	-	-	-	-	-	-	-	-	58	42	39
	2	In tank LP Pump discharge	Flange Leakage (10mm)	-165	10	1.40	Liq	1.5 /A	17	22	-	-	-	-					24	16	14
								1.5 / F	18	27	-	-	-	-					24	16	14
								2 / E	19	28	-	-	-	-					25	16	15
	3	High Pressure LNG Pump discharge	Instrument Tapping Failure (20mm)	-165	90	16.40	Liq	1.5 /A	82	193	87	78	65	63	-	-	-	-	131	102	96
								1.5 / F	80	176	87	78	65	63	-	-	-	-	125	94	87
								2 / E	81	184	84	75	62	60	-	-	-	-	133	103	97
	4	High Pressure LNG Pump discharge	Flange Leakage (10mm)	-165	90	4.20	Liq	1.5 /A	28	82	47	42	35	34					53	40	37
								1.5 / F	32	82	47	42	35	34					55	41	38
								2 / E	31	82	45	40	33	32					54	40	37
	5	Shell & Tube Vaporiser Inlet	Flange Joint Leakage (10mm)	-165	90	4.10	Liq	1.5 /A	28	82	47	42	35	34	-	-	-	-	53	40	38
								1.5 / F	32	82	47	42	35	34	-	-	-	-	55	41	38
								2 / E	31	82	45	40	33	32	-	-	-	-	54	40	37
	6	Shell & Tube Vaporiser Inlet	Instrument Tapping Failure (20mm)	-165	90	16.80	Liq	1.5 /A	82	193	87	78	65	63					131	102	96
								1.5 / F	80	160	87	78	65	63					125	94	87
								2 / E	81	184	84	75	62	60					133	103	97
	7	Shell & Tube Vaporiser Outlet	Flange Joint Leakage (10mm)	7	90	1.20	Gas	1.5 /A	8	16	18	16	13	13	-	-	-	-	-	-	-
								1.5 / F	8	17	18	16	13	13	-	-	-	-	-	-	-
								2 / E	8	16	18	16	13	13	-	-	-	-	-	-	-
	8	Shell & Tube Vaporiser Outlet	Instrument Tapping Failure (20mm)	7	90	5.20	Gas	1.5 /A	17	36	37	33	27	25					24	16	14
								1.5 / F	17	40	37	33	27	25					24	16	14
								2 / E	17	40	37	33	27	25					24	16	14
	9	Loading Arm Leakage	10 mm	-165	10	1.37	Liq	1.5 /A	34	62	33	29	25	25	-	-	-	-	52	39	37
								1.5 / F	38	72	33	29	25	25	-	-	-	-	56	41	38
								2 / E	35	64	32	28	23	23	-	-	-	-	53	40	37
	10	Loading Arm Rupture	75mm	-165	10	6.88	Liq	1.5 /A	93	132	67	59	48	47	-	-	-	-	150	116	109
								1.5 / F	108	172	67	59	48	47	-	-	-	-	185	137	126
								2 / E	94	143	64	57	46	44	-	-	-	-	156	118	111
	11	Metering Yard	Instrument Tapping Failure (20mm)	7	90	5.17	Gas	1.5 /A	17	36	37	33	27	25	-	-	-	-	24	16	14
								1.5 / F	17	40	37	33	27	25	-	-	-	-	24	16	14
								2 / E	17	40	37	33	27	25	-	-	-	-	24	16	14
	12	Hot Oil Pump Discharge	Instrument Tapping Failure (20mm)	25	2.7	2.50	Liquid	1.5 /A	31	51	38	32	26	25	77	62	40	36	52	39	37
								1.5 / F	37	66	38	32	26	25	77	62	40	36	55	41	38
								2 / E	33	54	37	32	25	24	77	62	41	38	53	40	37
	13	Hot Oil Storage Tank	Tank on fire	25	1	_	Liquid	1.5 /A	_	_	_	_	_	_	26	20	11	9	_	_	_
								1.5 / F	_	_	_	_	_	_	26	20	11	9	_	_	_
								2 / E	_	_	_	_	_	_	27	21	12	10	_	_	_

Note

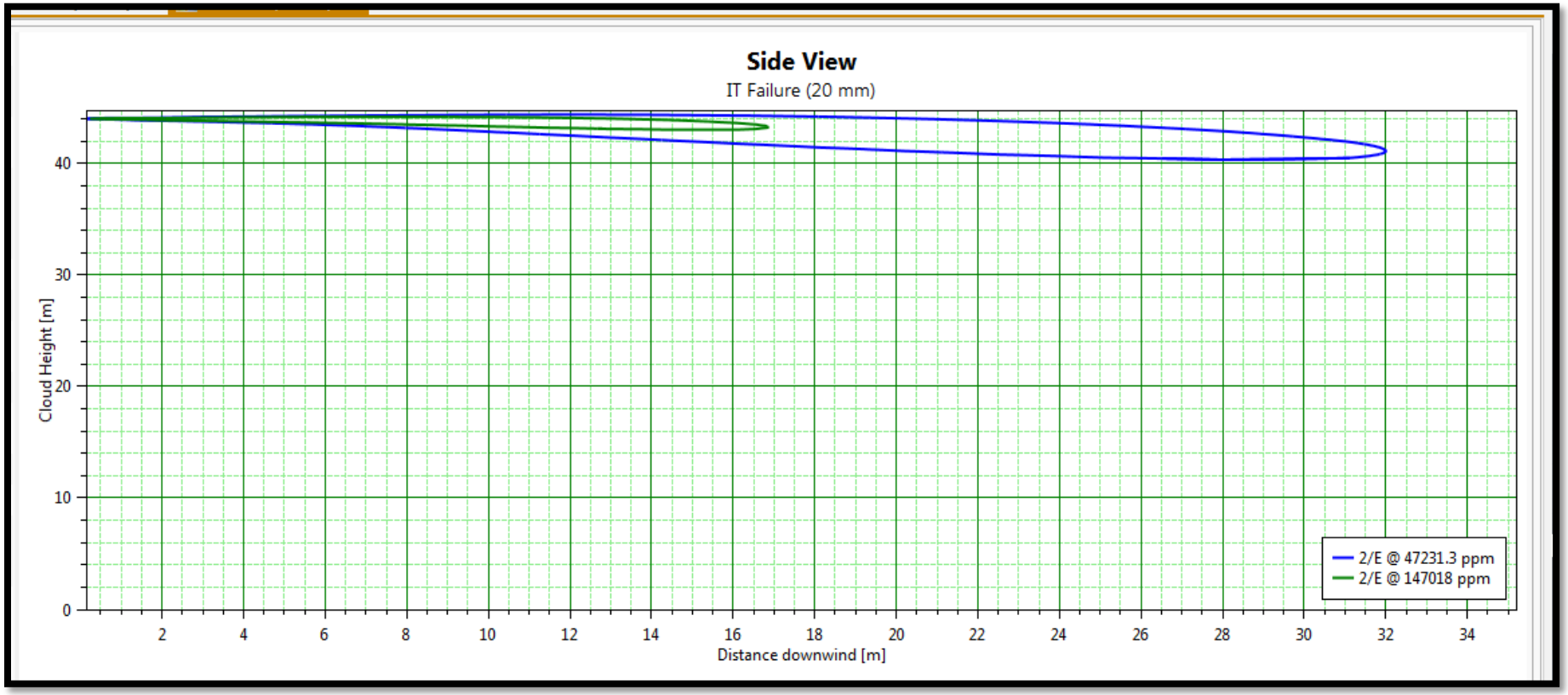
Distances mentioned in the **"Red"** color are not realized at the ground.

ANNEXURE-II

Consequence Analysis Contours

1. In tank LP Pump discharge

Figure- 1.1.1: 20 mm leak; Flash Fire Distances (m)



Not reached at grade level for this case.

Figure- 1.1.2: 20 mm leak; Blast Overpressure Distances (m)

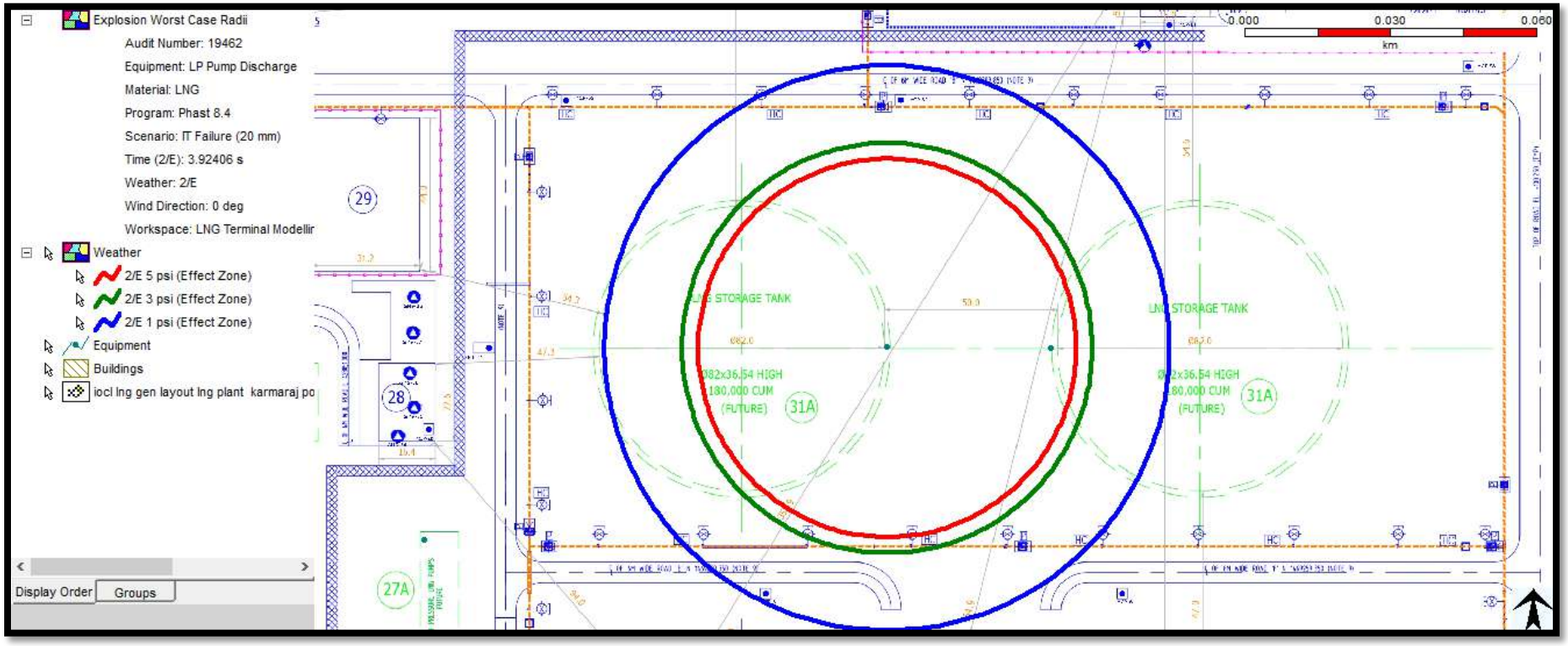


Figure- 1.2.1: 10 mm leak; Flash Fire Distances (m)

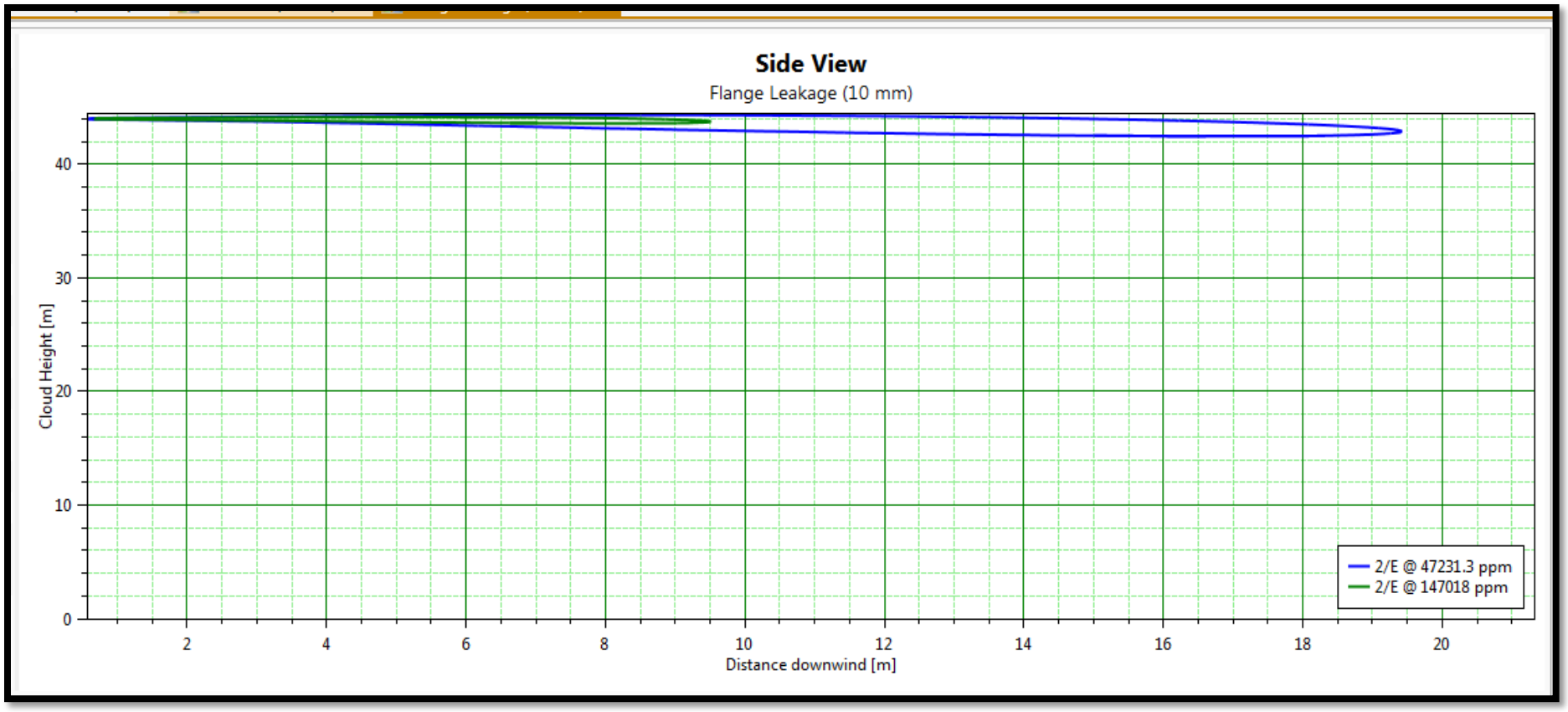
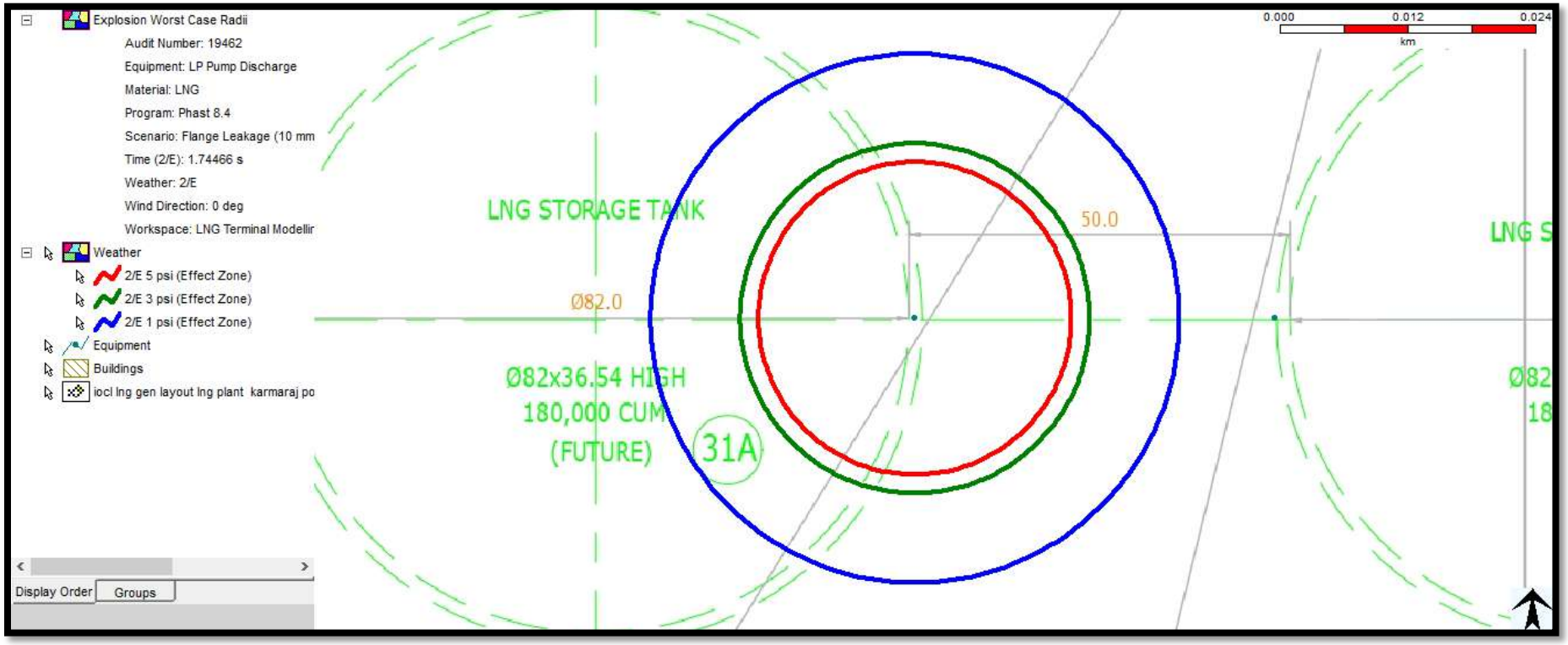


Figure- 1.2.2: 10 mm leak; Blast Overpressure Distances (m)



2. High Pressure LNG Pump discharge

Figure- 2.1.1: 20 mm leak; Flash Fire Distances (m)

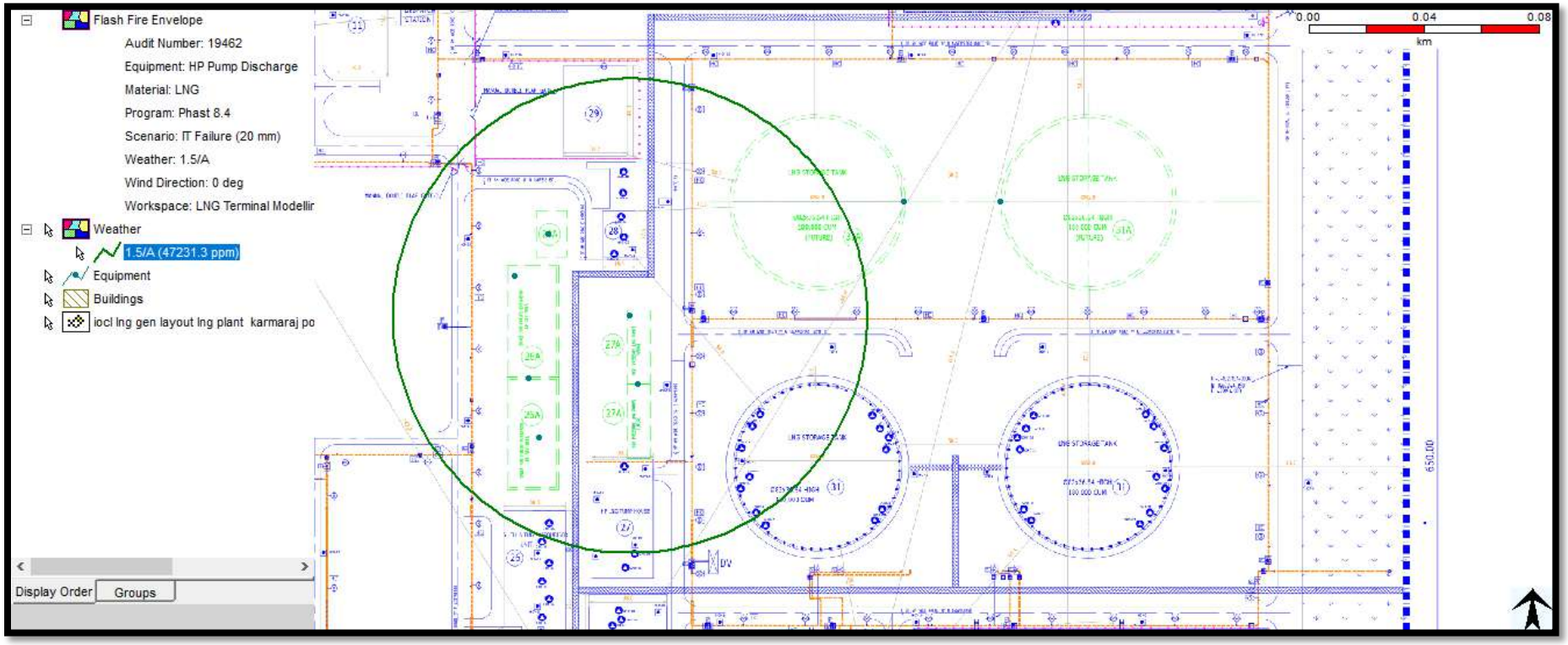


Figure- 2.1.2: 20 mm leak; Jet Fire Distances (m)

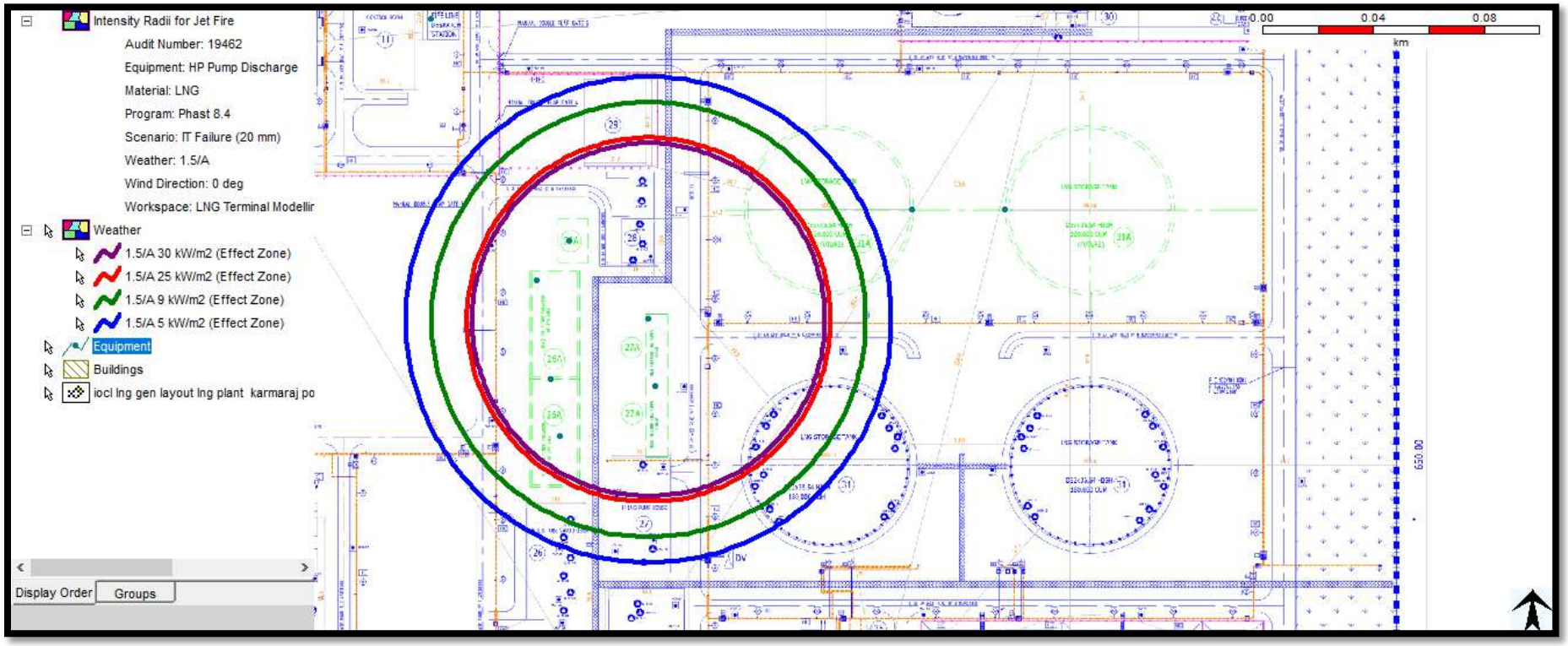


Figure- 2.1.3: 20 mm leak; Blast Overpressure Distances (m)

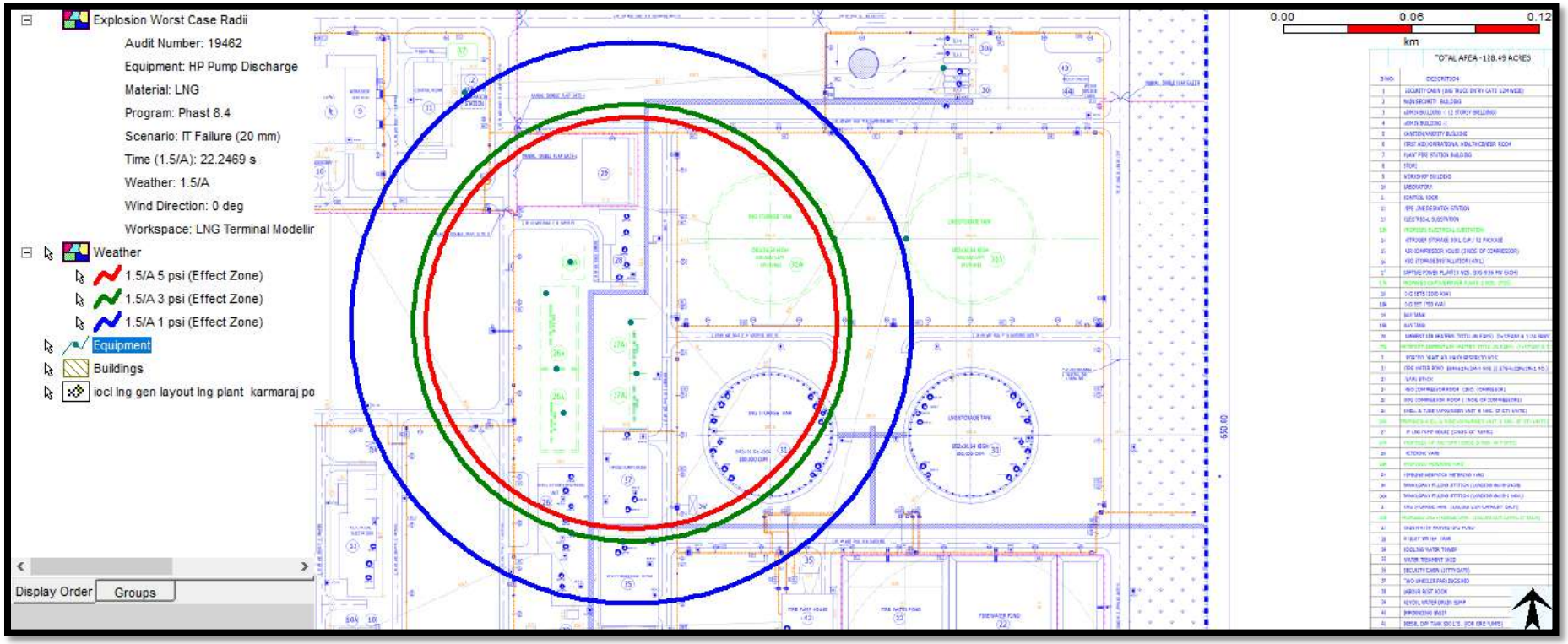


Figure- 2.2.1: 10 mm leak; Flash Fire Distances (m)

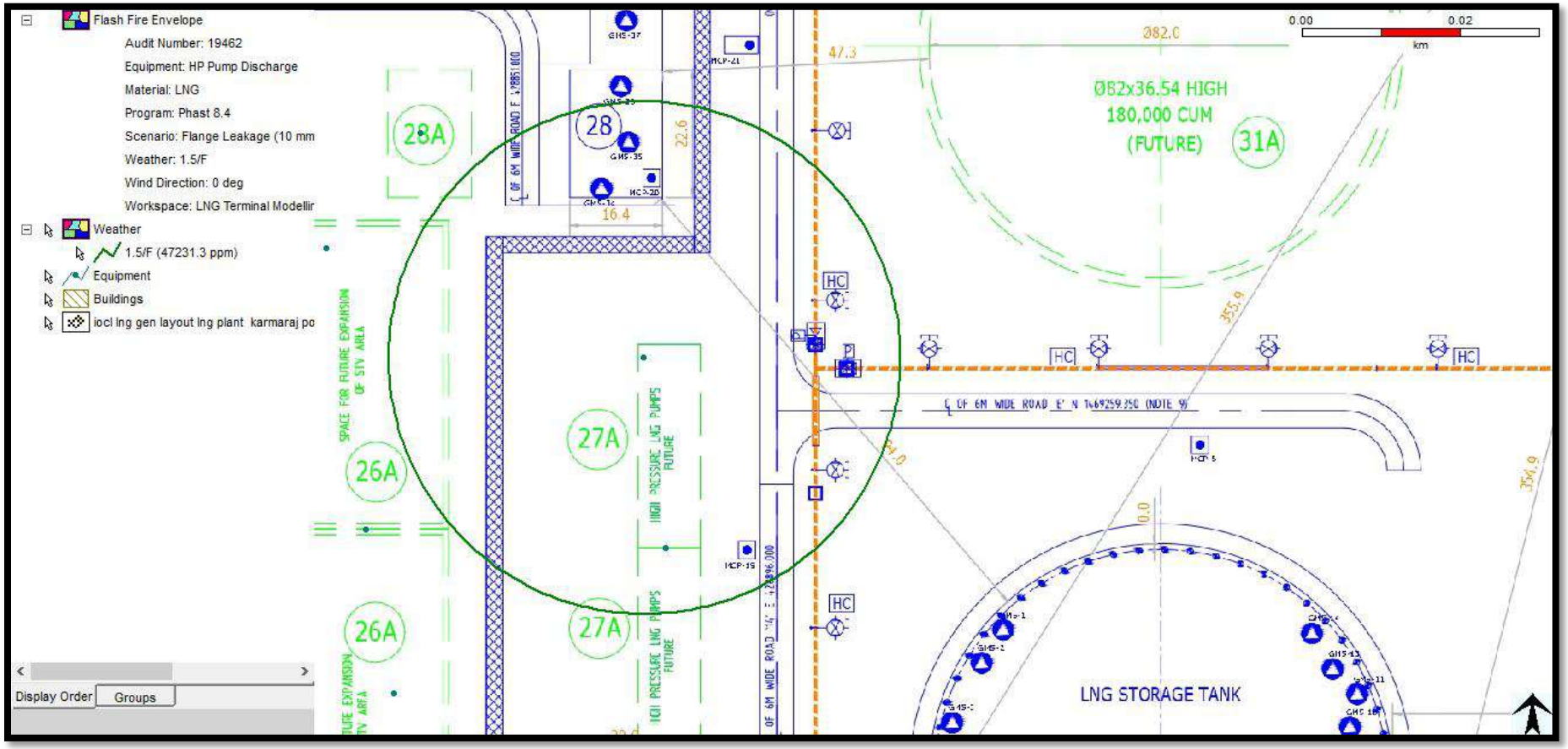


Figure- 2.2.2: 10 mm leak; Jet Fire Distances (m)

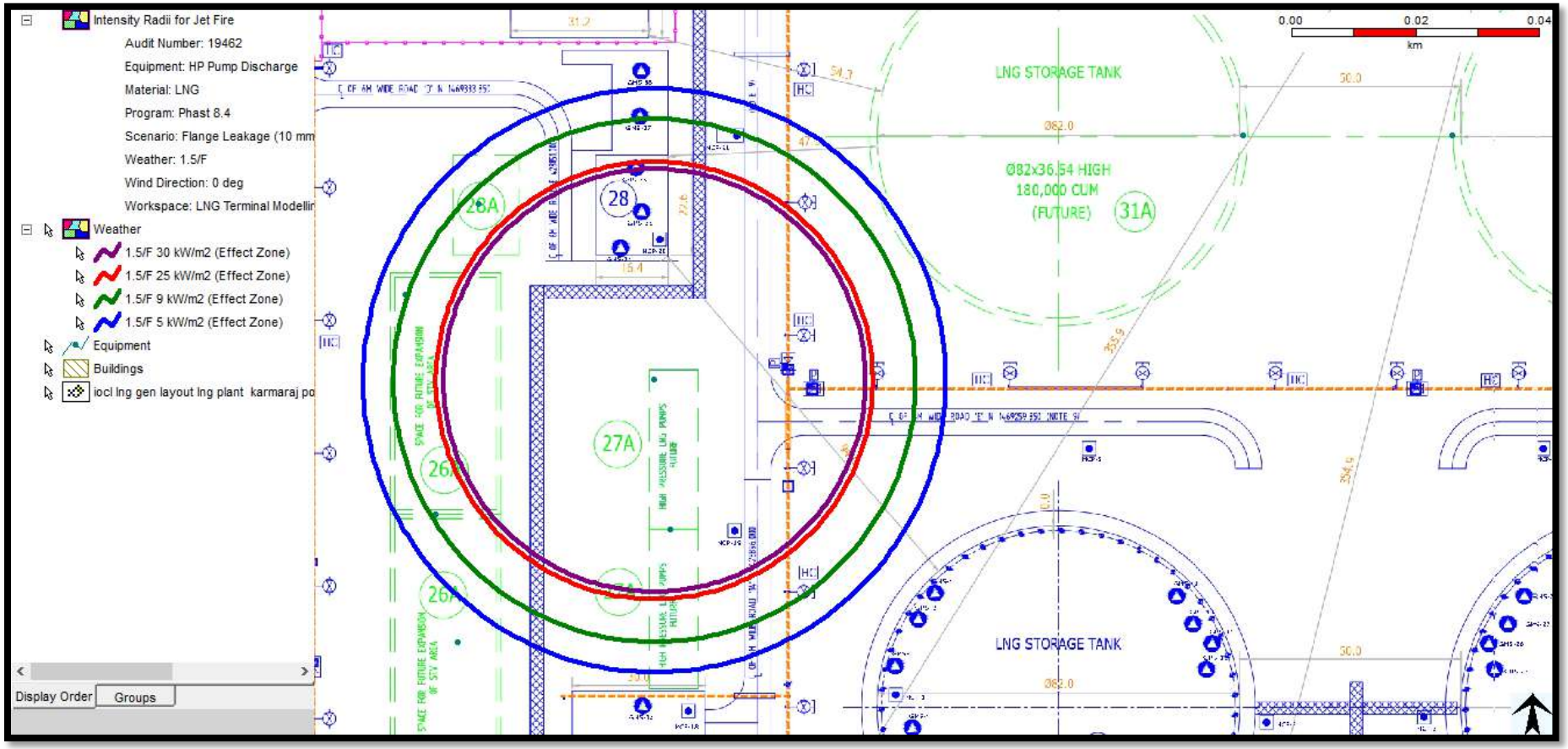
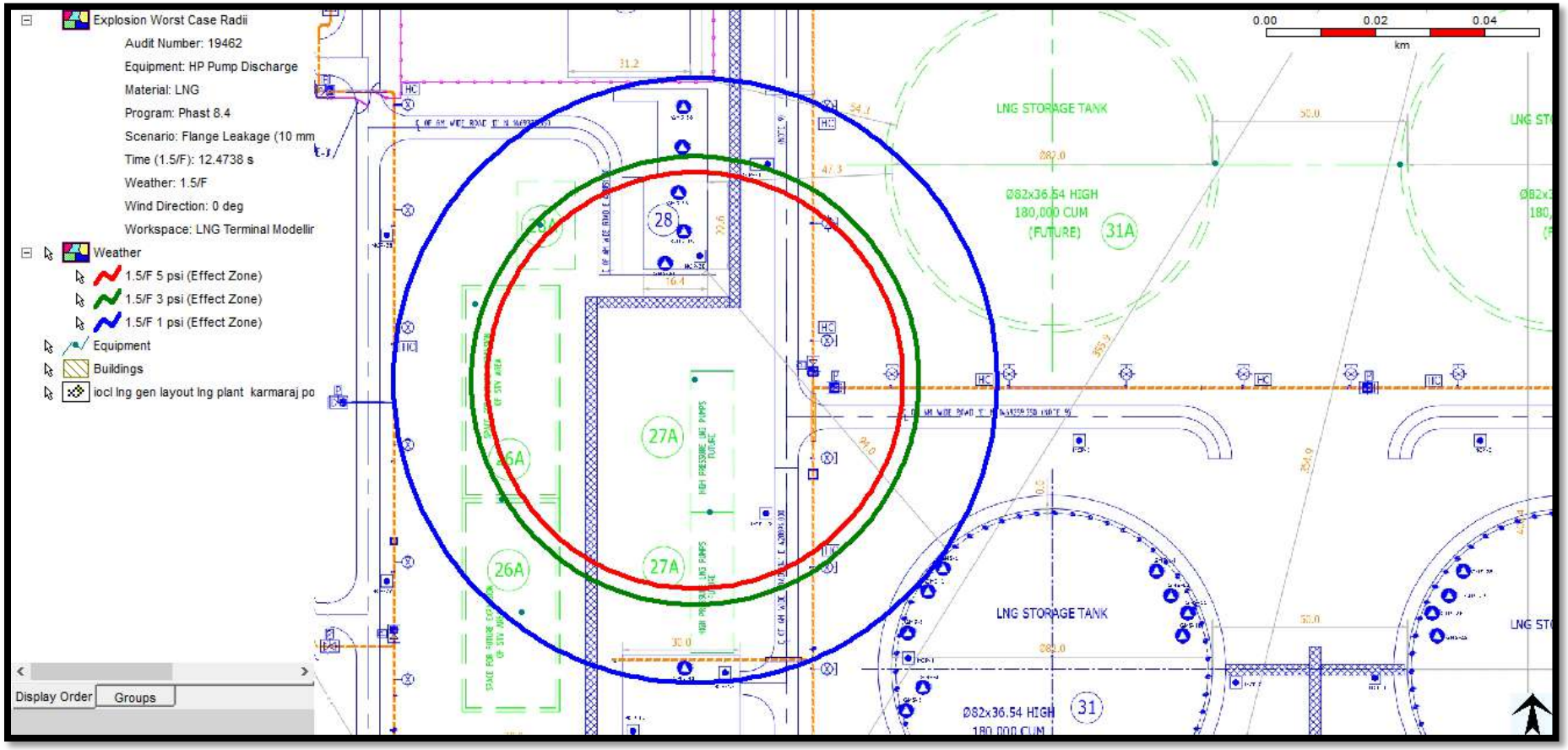


Figure- 2.2.3: 10 mm leak; Blast Overpressure Distances (m)



3. Shell & Tube Vaporiser Inlet

Figure- 3.1.1: 10 mm leak; Flash Fire Distances (m)

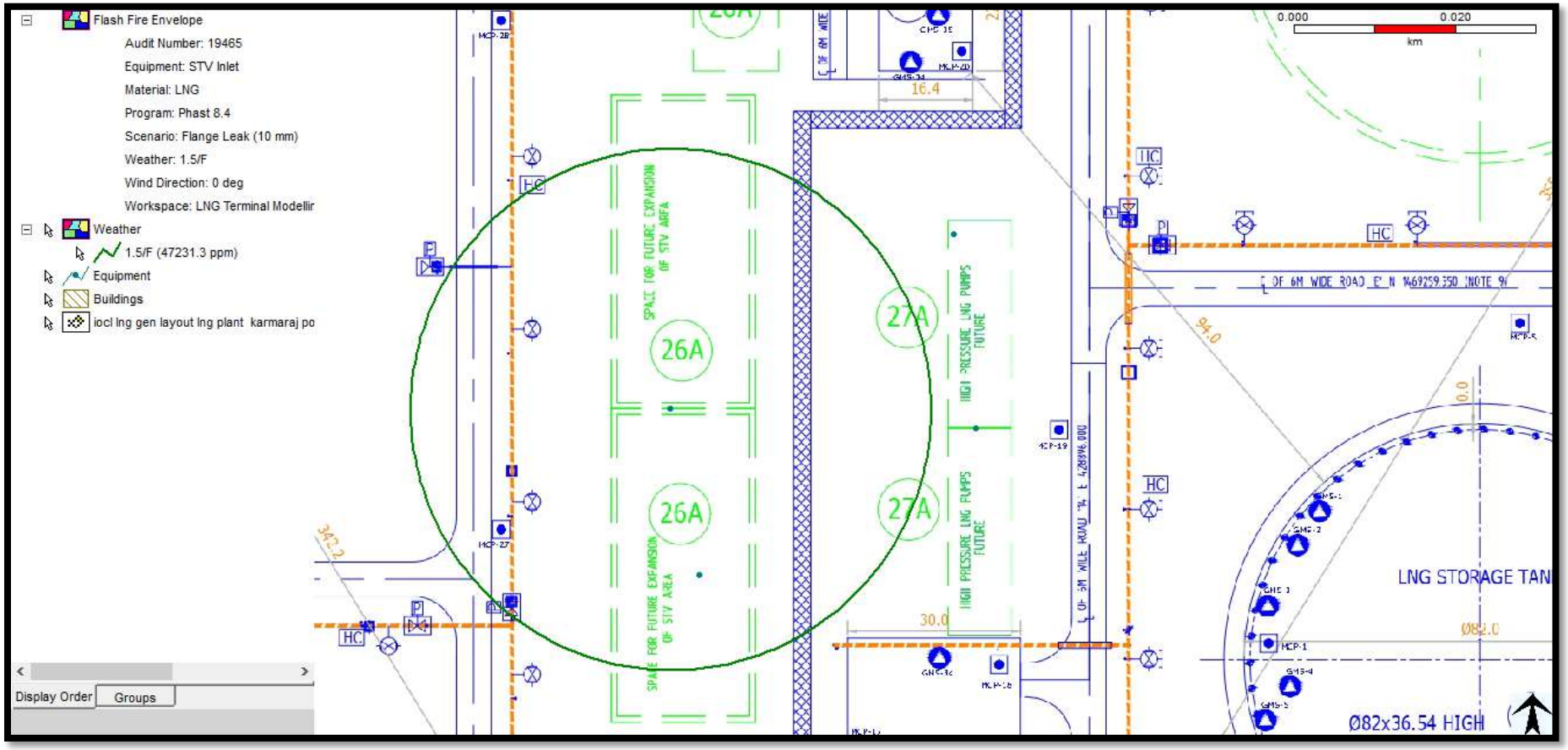


Figure- 3.1.2: 10 mm leak; Jet Fire Distances (m)

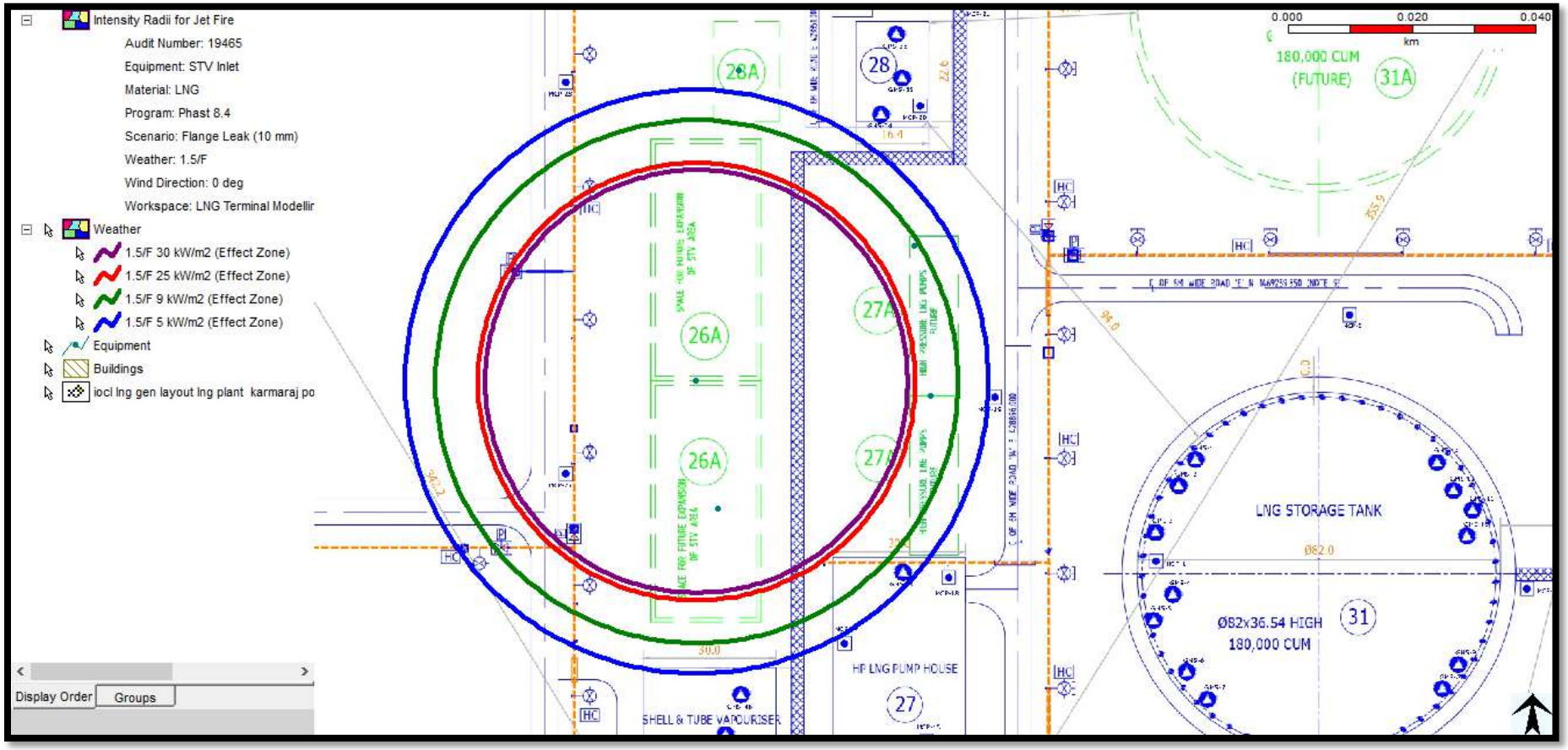


Figure- 3.1.3: 10 mm leak; Blast Overpressure Distances (m)

Figure: 3.1.3.1

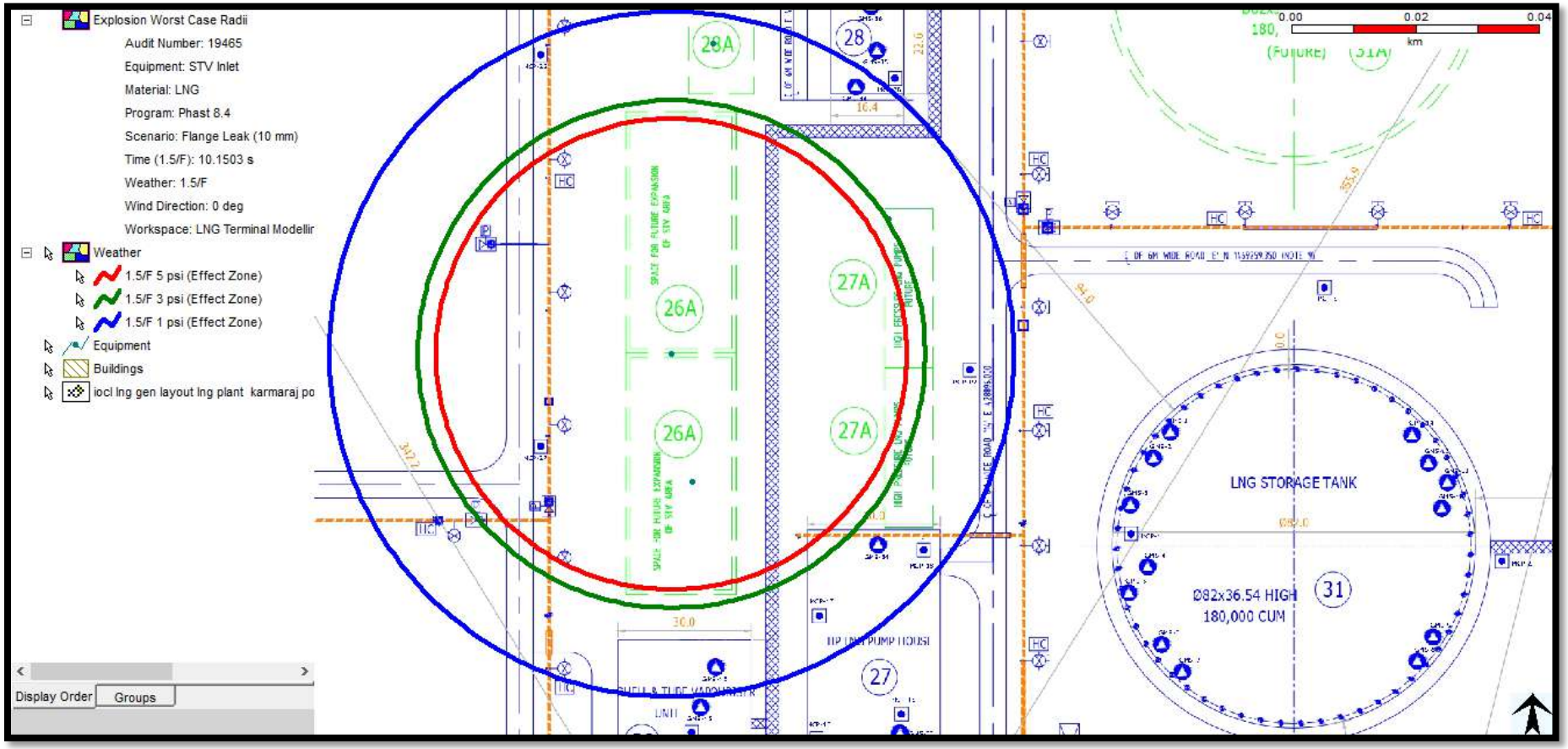


Figure: 3.1.3.2

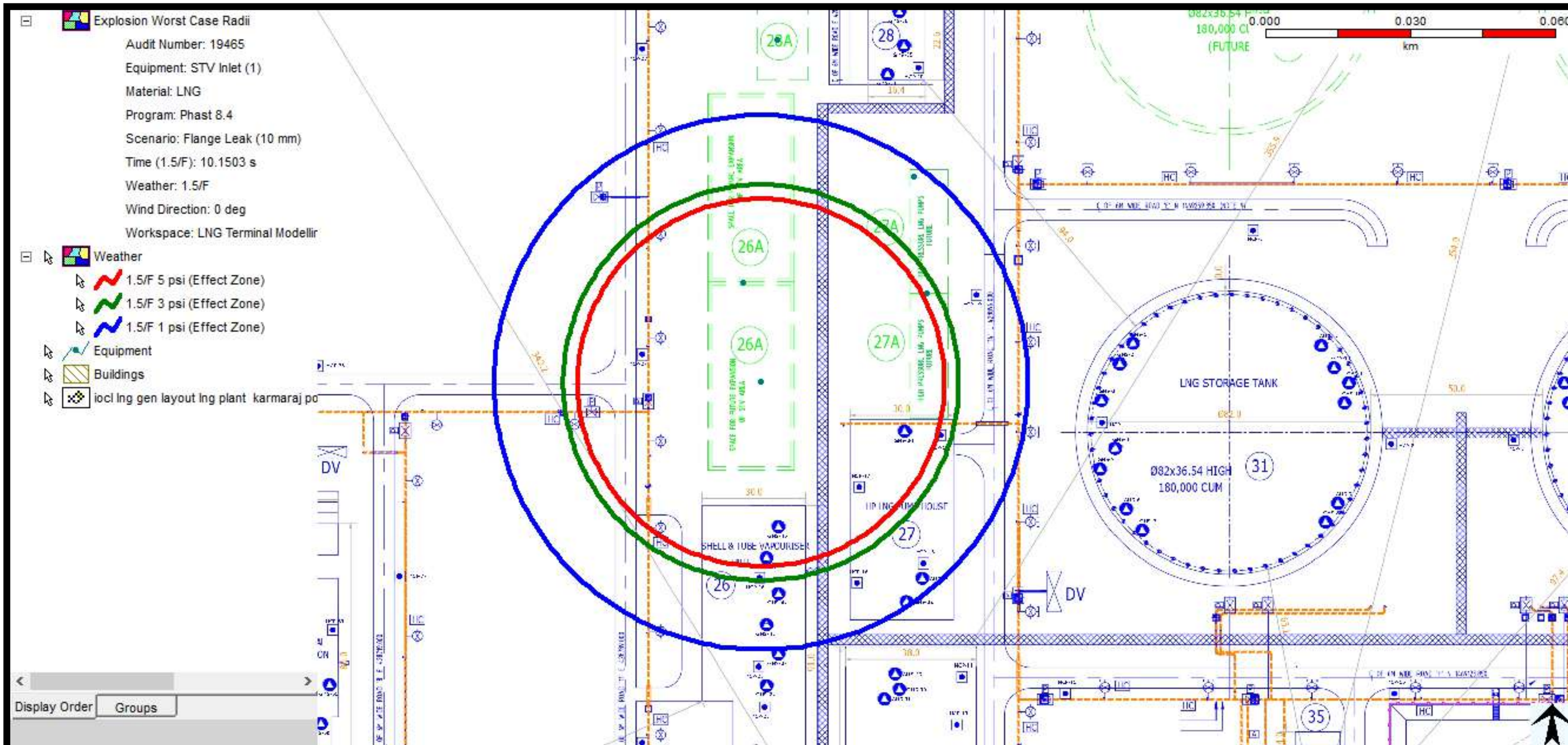

Explosion Worst Case Radii
Audit Number: 19465
Equipment: STV Inlet (1)
Material: LNG
Program: Phast 8.4
Scenario: Flange Leak (10 mm)
Time (1.5/F): 10.1503 s
Weather: 1.5/F
Wind Direction: 0 deg
Workspace: LNG Terminal Modellir
Weather
1.5/F 5 psi (Effect Zone)
1.5/F 3 psi (Effect Zone)
1.5/F 1 psi (Effect Zone)
Equipment
Buildings
iocl lng gen layout lng plant karmaraj po
Display Order
Groups
0.000
0.030
0.060
km
LNG STORAGE TANK
Ø82x36.54 HIGH
180,000 CUM
SHELL & TUBE VAPOURISER
DV
26A
27A
28
26
27
31
35

Figure- 3.2.1: 20 mm leak; Flash Fire Distances (m) :

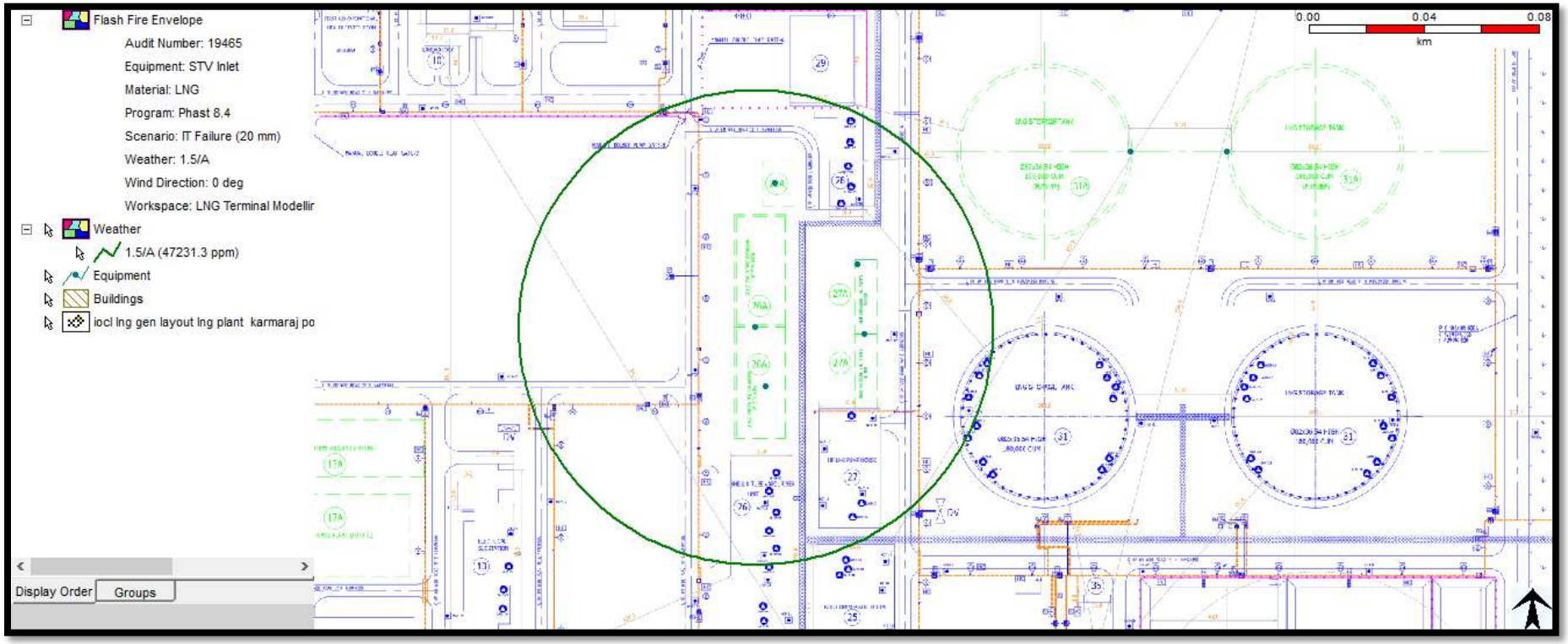


Figure- 3.2.2: 20 mm leak; Jet Fire Distances (m)

Figure- 3.2.2.1

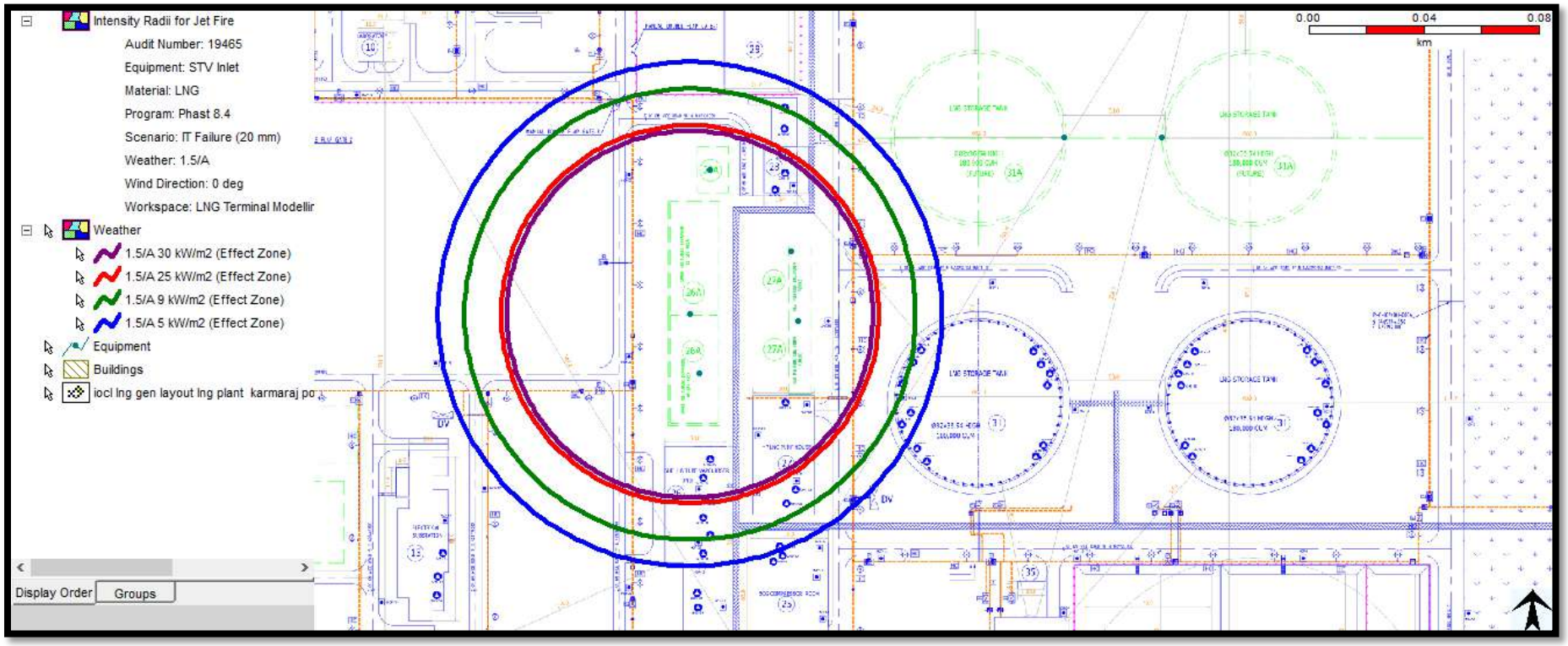


Figure- 3.2.2.2

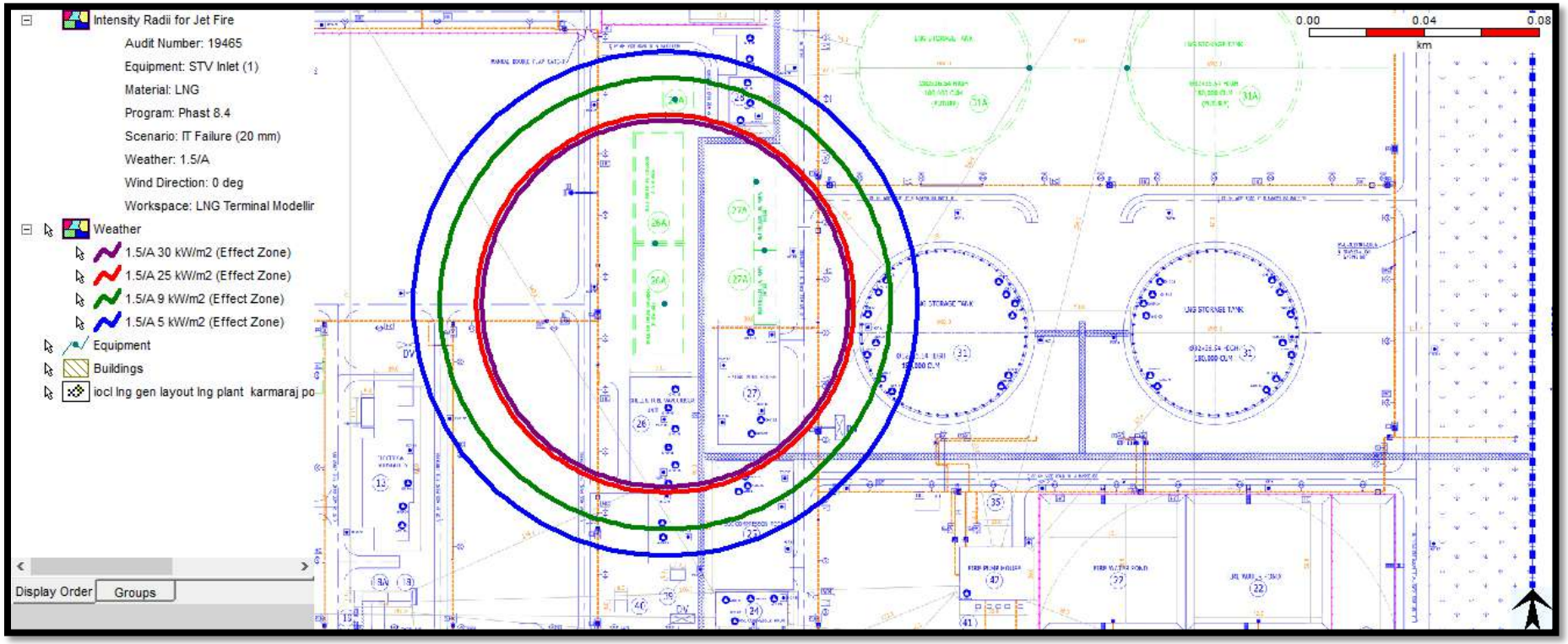

Intensity Radii for Jet Fire
Audit Number: 19465
Equipment: STV Inlet (1)
Material: LNG
Program: Phast 8.4
Scenario: IT Failure (20 mm)
Weather: 1.5/A
Wind Direction: 0 deg
Workspace: LNG Terminal Modellir
Weather
1.5/A 30 kW/m2 (Effect Zone)
1.5/A 25 kW/m2 (Effect Zone)
1.5/A 9 kW/m2 (Effect Zone)
1.5/A 5 kW/m2 (Effect Zone)
Equipment
Buildings
iocl lng gen layout lng plant karmaraj po
Display Order
Groups
0.00
0.04
0.08
km

Figure- 3.2.3: 20 mm leak; Blast Overpressure Distances (m)

Figure- 3.2.3.1

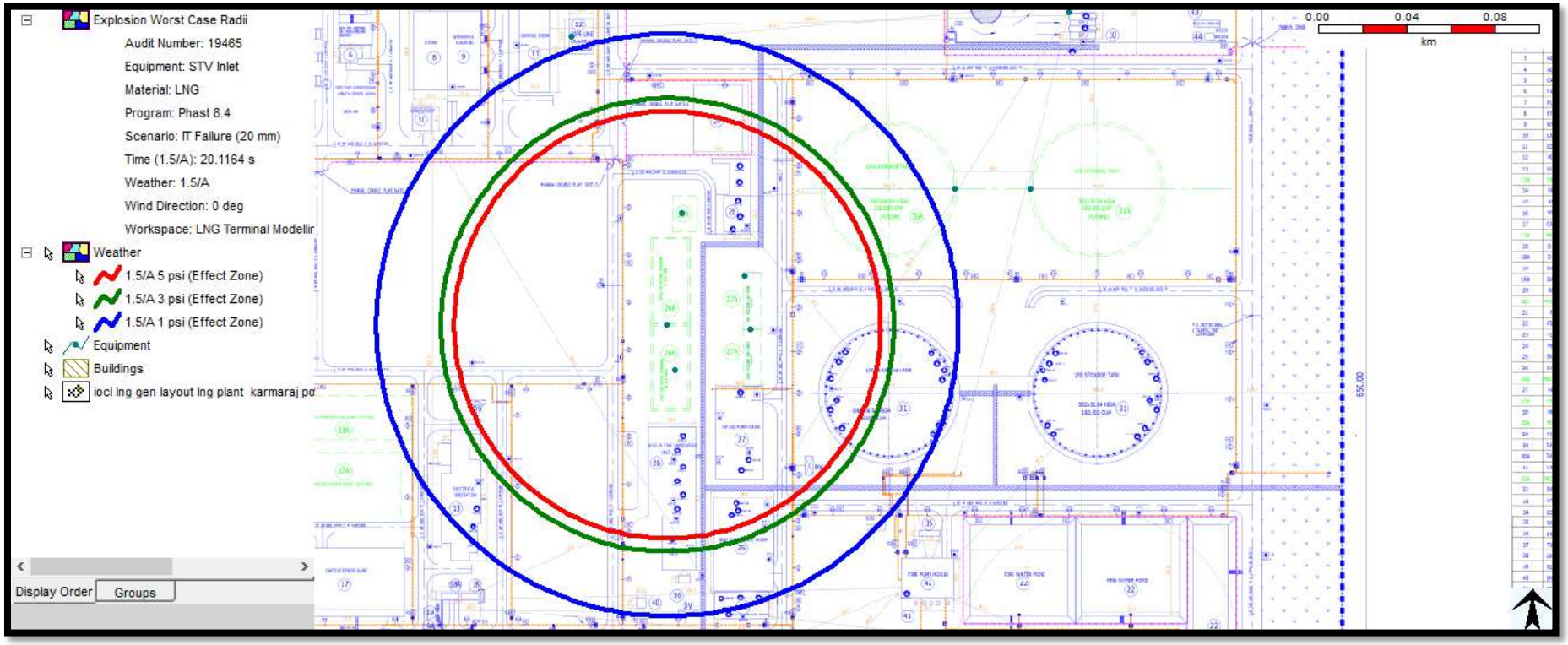
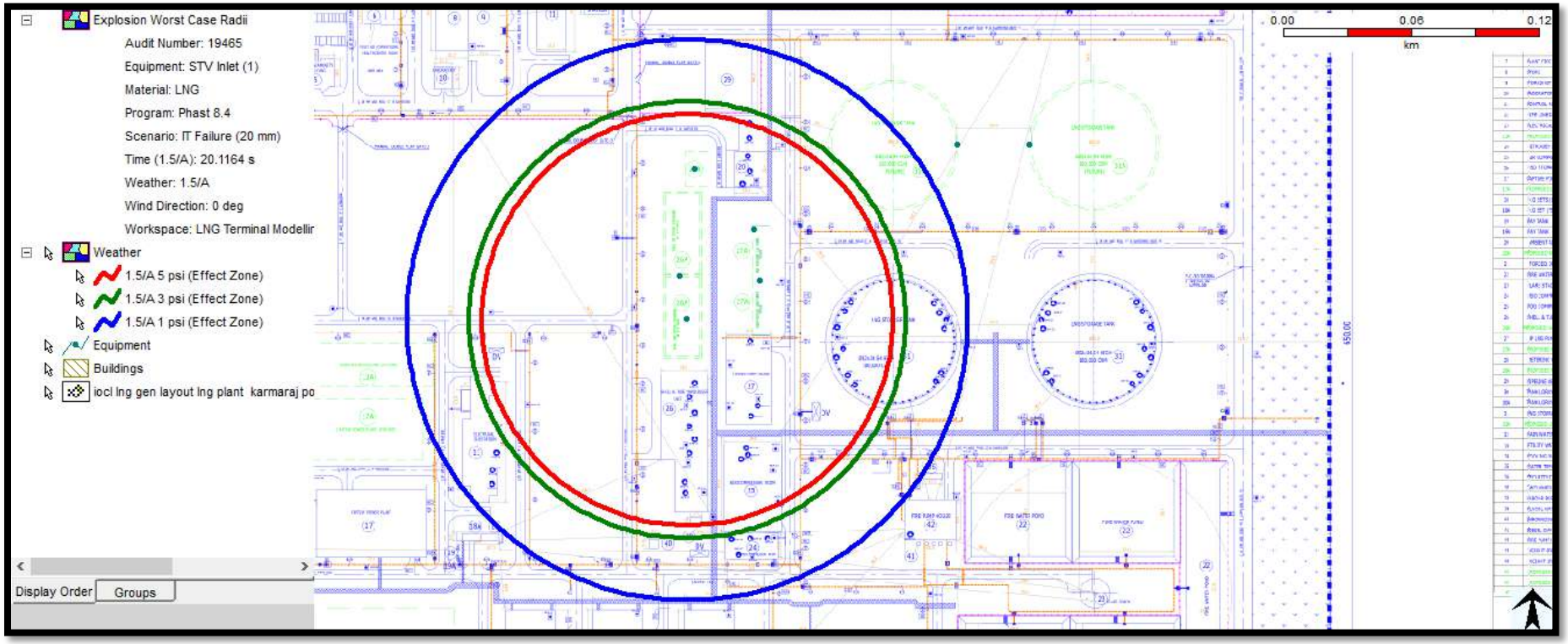
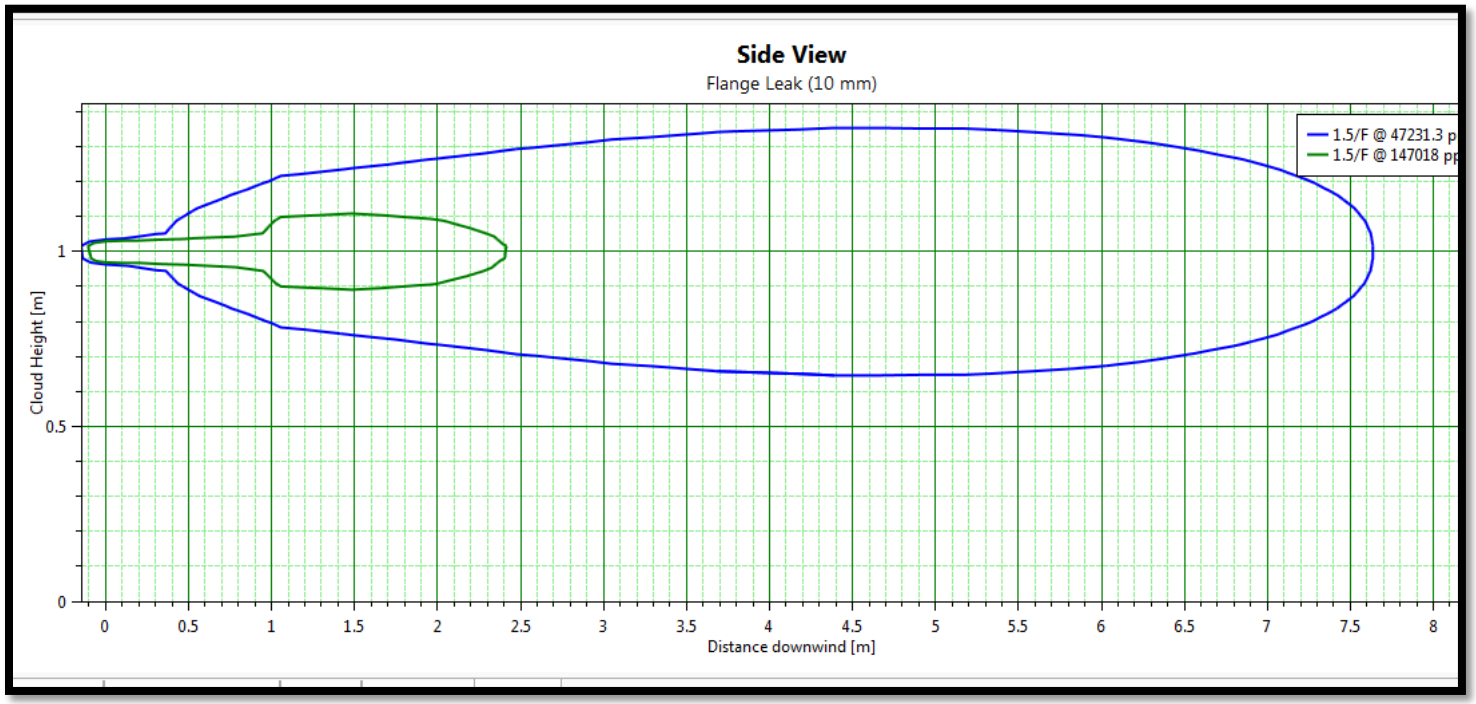


Figure- 3.2.3.2


Explosion Worst Case Radii
Audit Number: 19465
Equipment: STV Inlet (1)
Material: LNG
Program: Phast 8.4
Scenario: IT Failure (20 mm)
Time (1.5/A): 20.1164 s
Weather: 1.5/A
Wind Direction: 0 deg
Workspace: LNG Terminal Modellir
Weather
1.5/A 5 psi (Effect Zone)
1.5/A 3 psi (Effect Zone)
1.5/A 1 psi (Effect Zone)
Equipment
Buildings
iocl lng gen layout lng plant karmaraj po
Display Order
Groups
0.00
0.06
0.12
km

4. Shell & Tube Vaporiser Outlet

Figure- 4.1.1: 10 mm leak; Flash Fire Distances (m)



Not reached at grade level for this case.

Figure- 4.1.2: 10 mm leak; Jet Fire Distances (m)

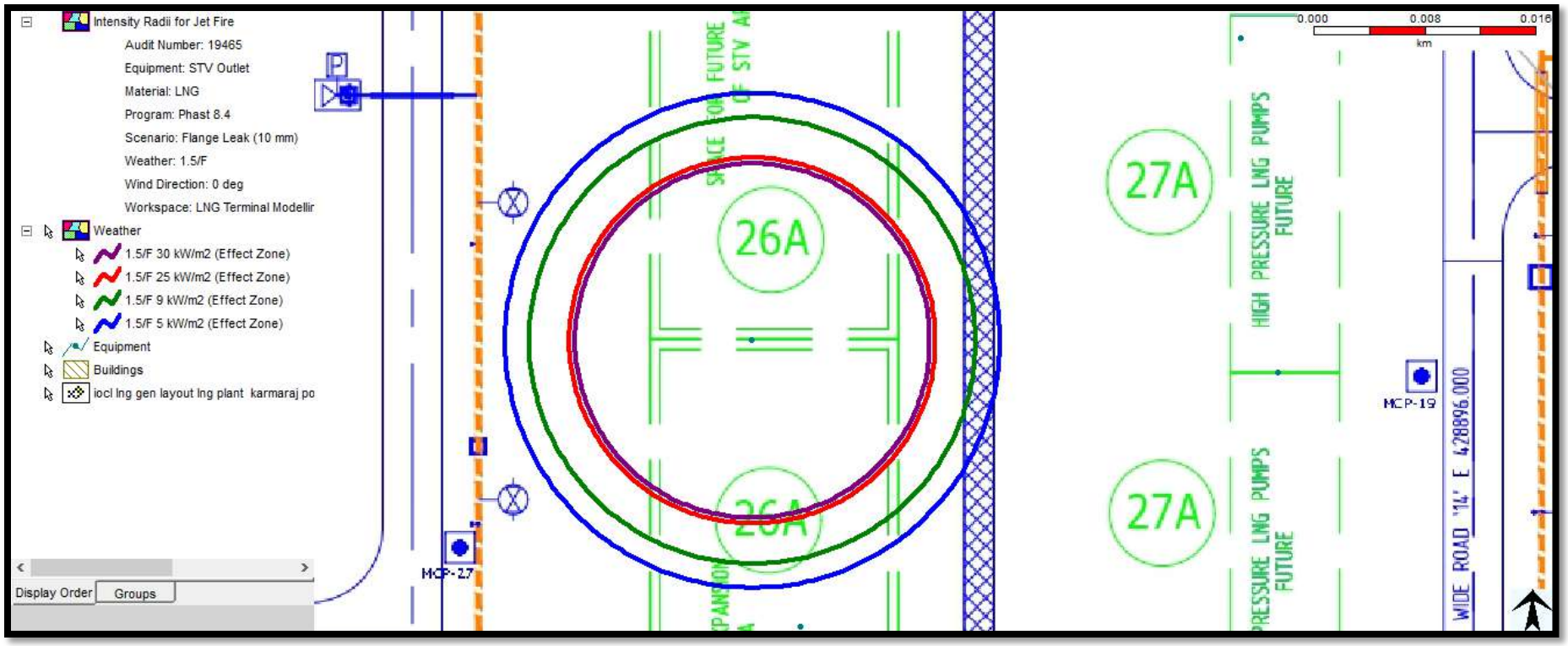


Figure- 4.2.1: 20 mm leak; Flash Fire Distances (m)

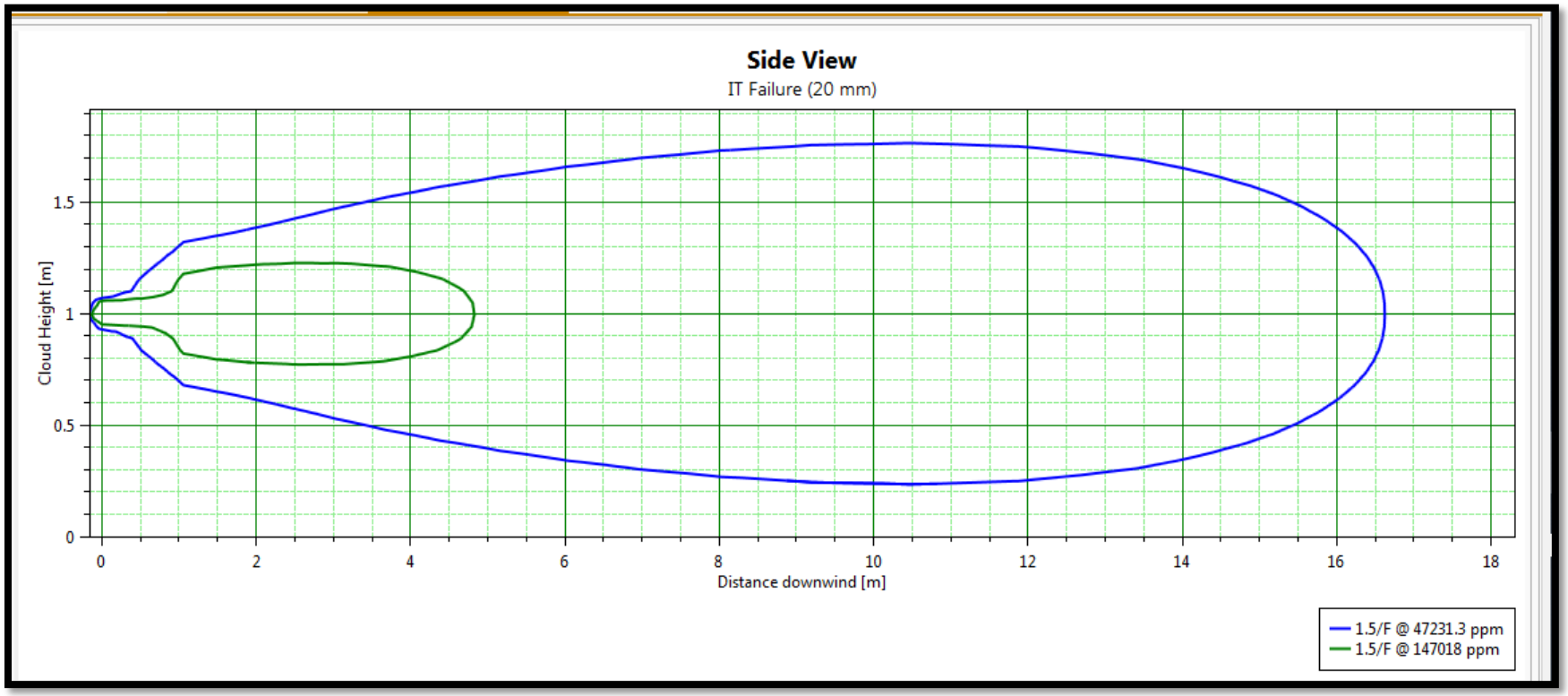


Figure- 4.2.2: 20 mm leak; Jet Fire Distances (m)

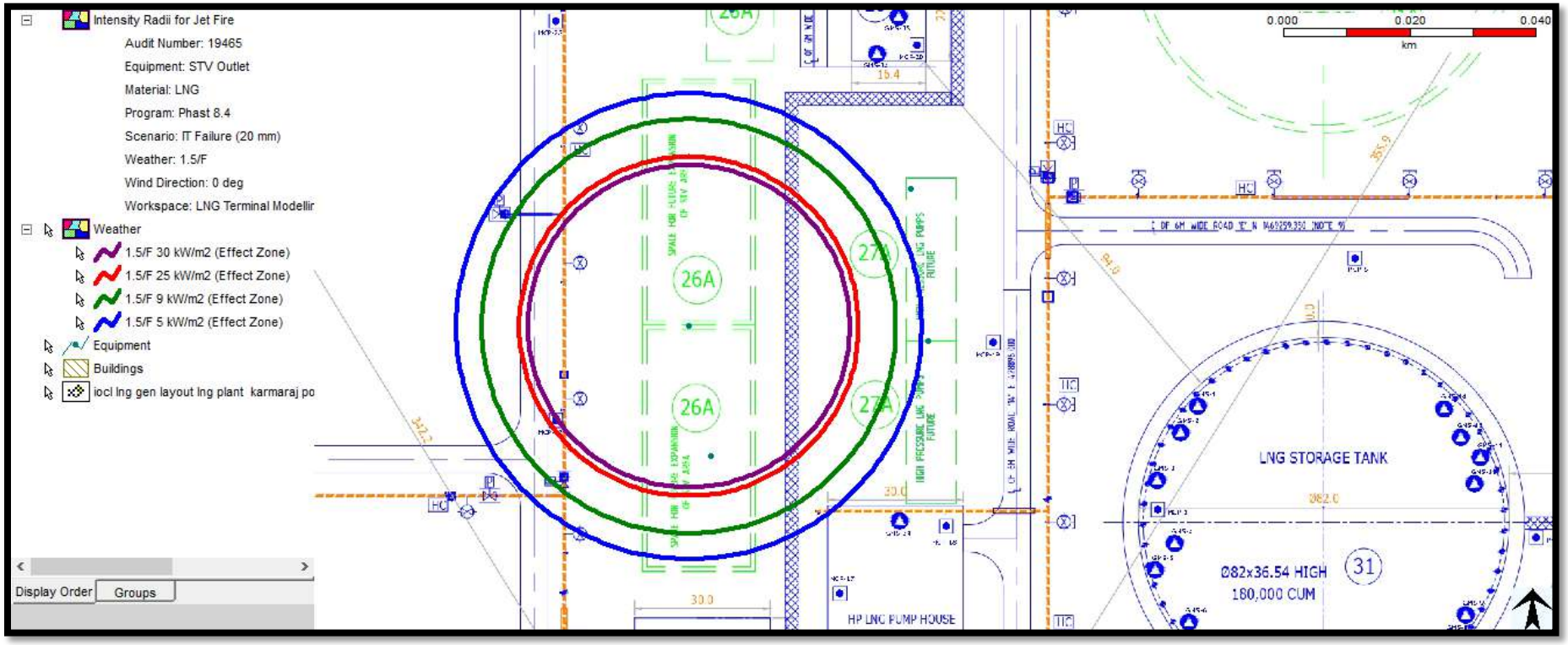
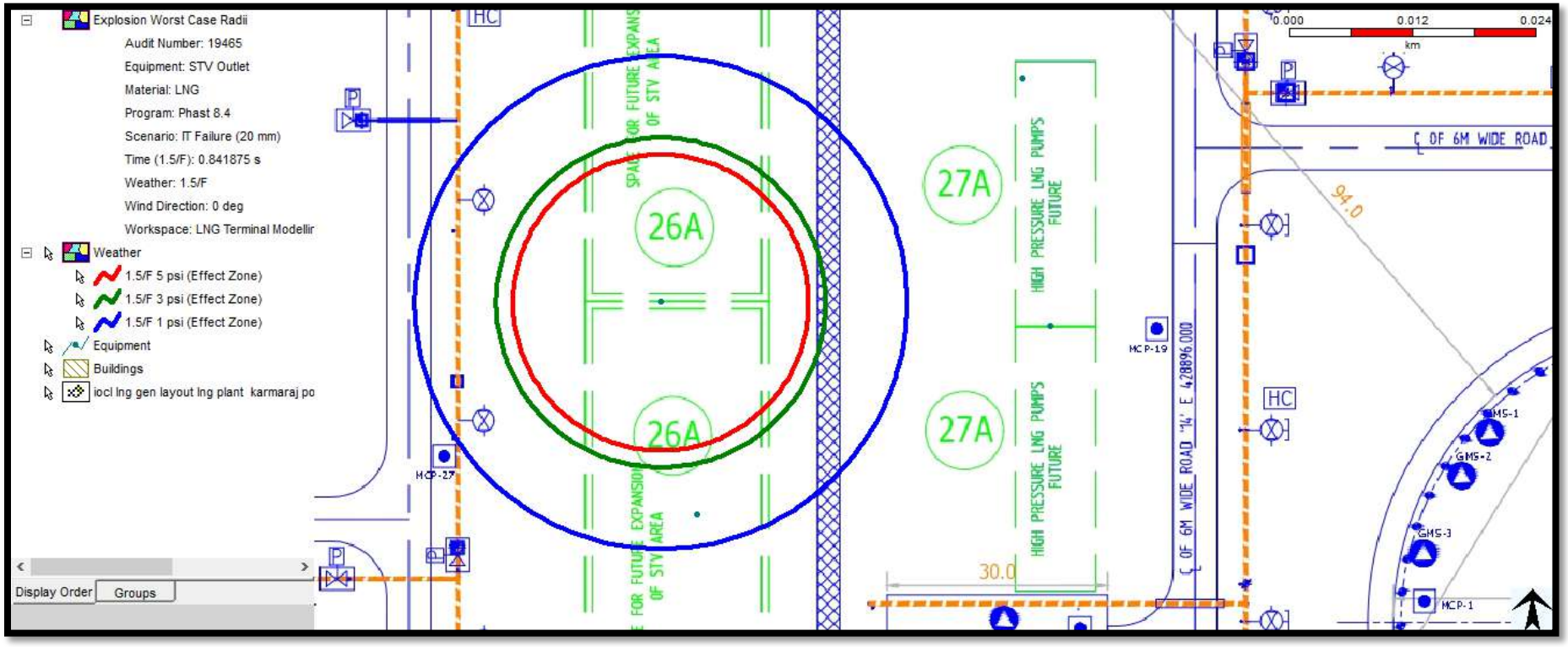


Figure- 4.2.3: 20 mm leak; Blast Overpressure Distances (m)



5. Loading Arm Leakage

Figure- 5.1.1: 10 mm leak; Flash Fire Distances (m)

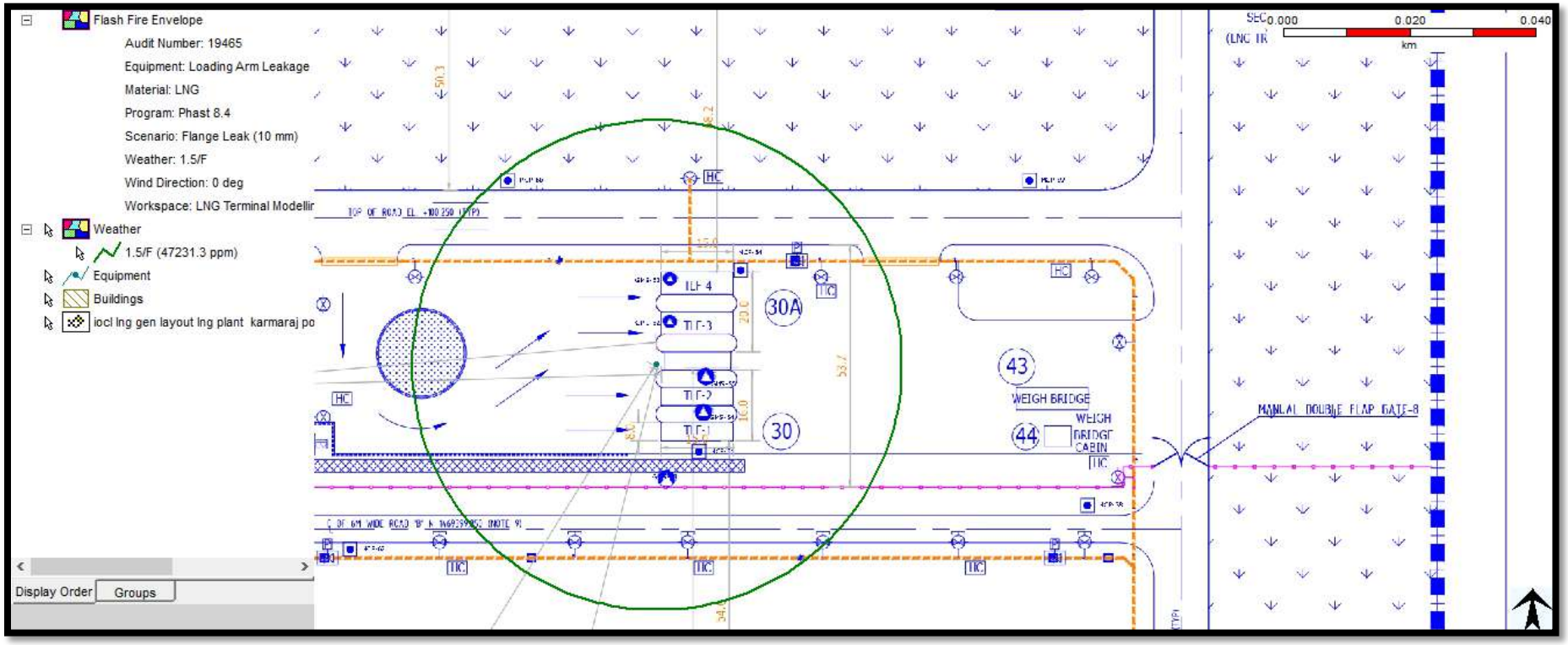


Figure- 5.1.2: 10 mm leak; Jet Fire Distances (m)

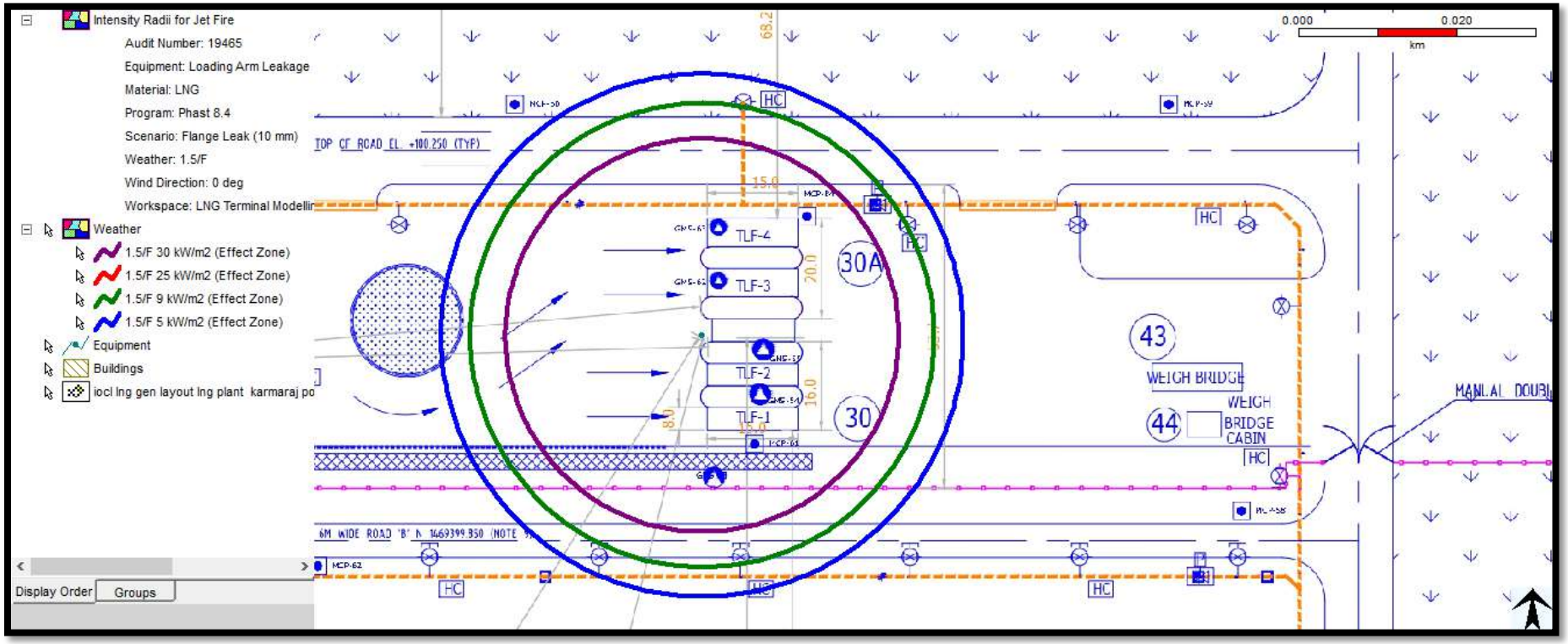
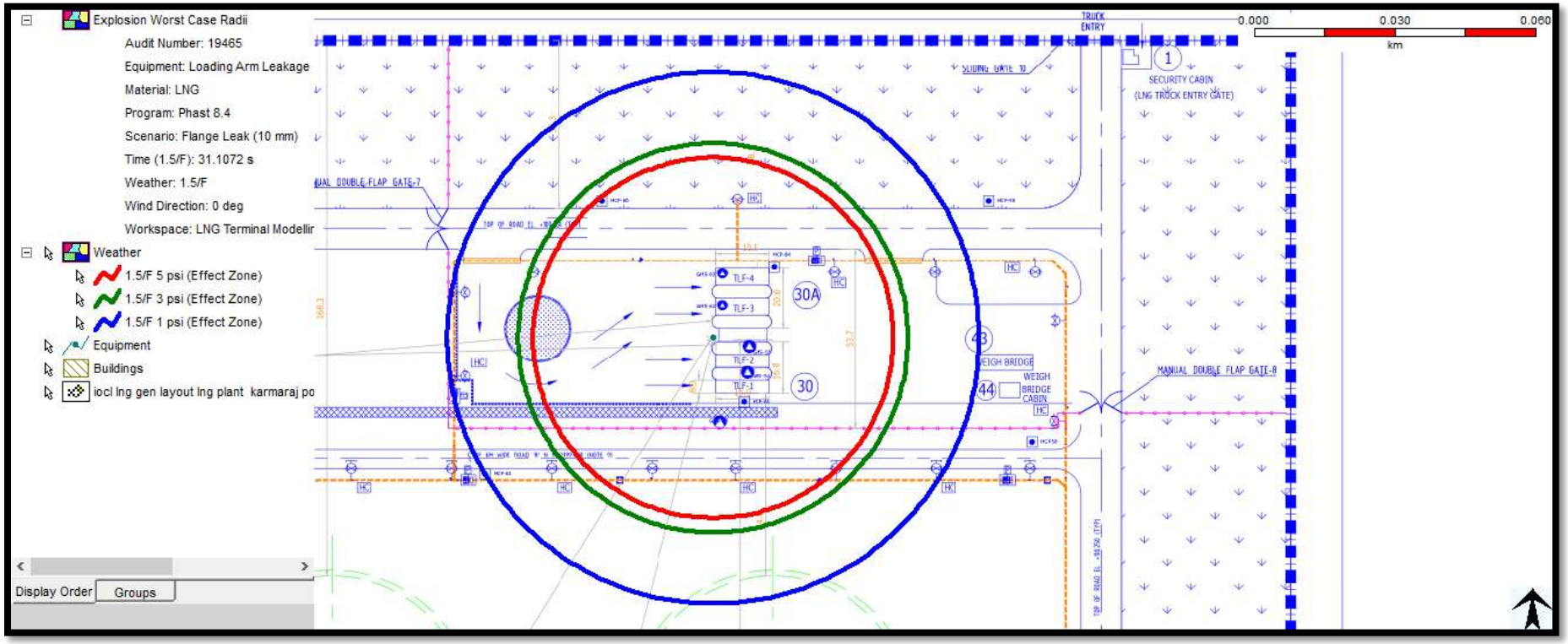


Figure- 5.1.3: 10 mm leak; Blast Overpressure Distances (m)



6. Loading Arm Rupture

Figure- 6.1.1: Rupture; Flash Fire Distances (m)

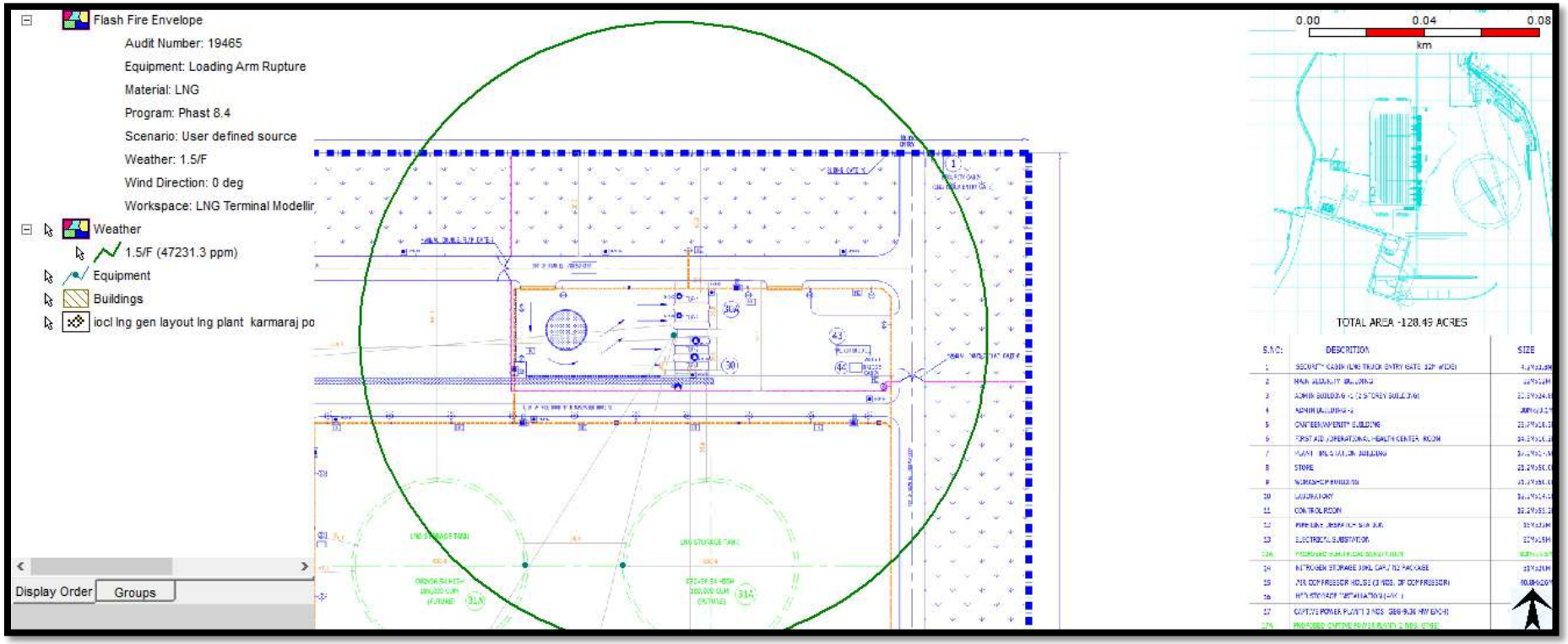


Figure- 6.1.2: Rupture; Jet Fire Distances (m)

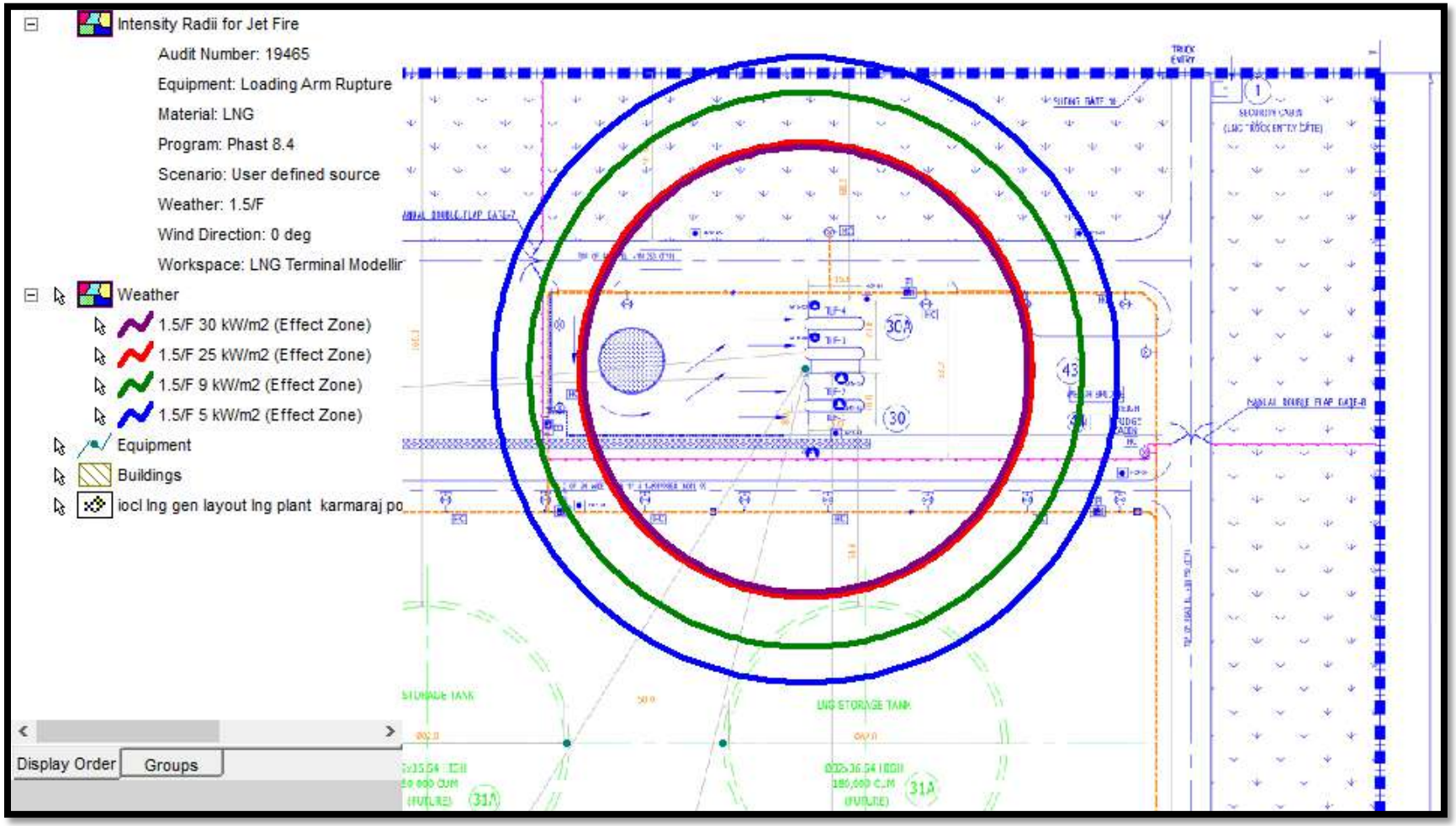
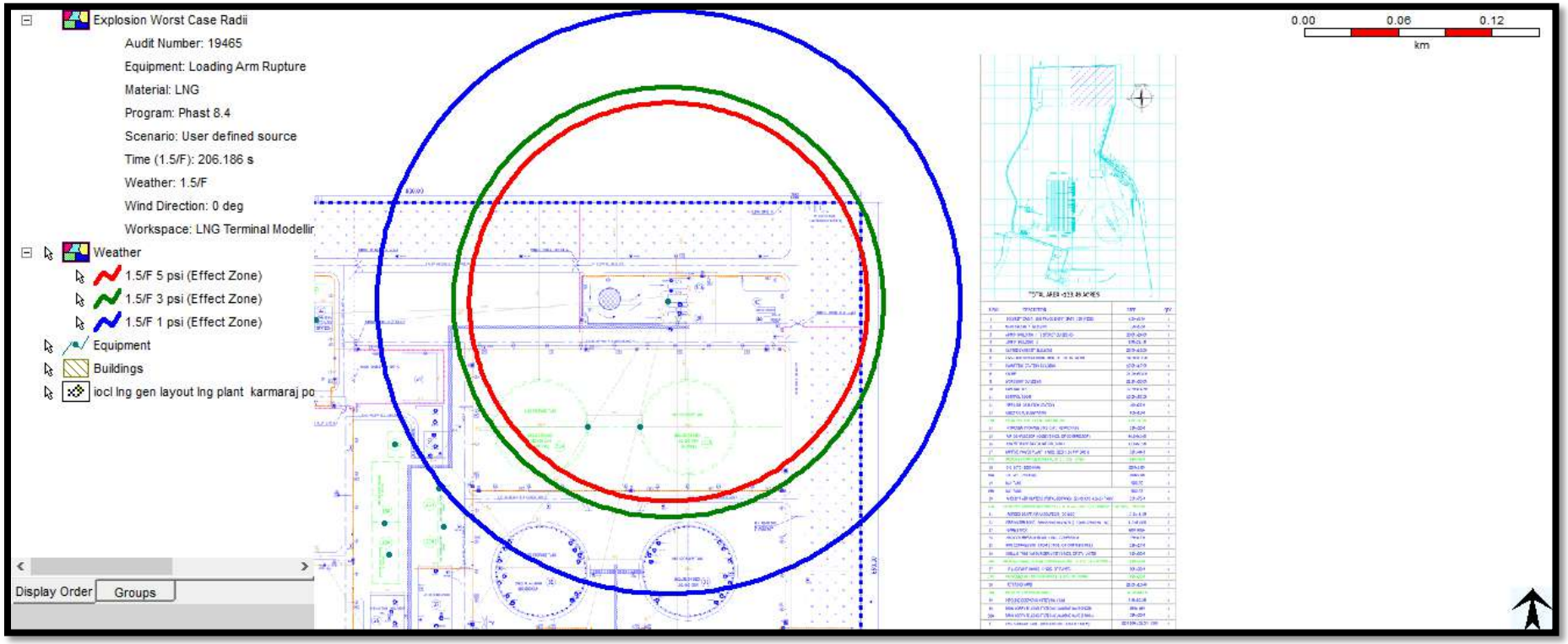


Figure- 6.1.3: Rupture; Blast Overpressure Distances (m)



7. Metering Yard

Figure- 7.1.1: 20 mm leak; Flash Fire Distances (m)

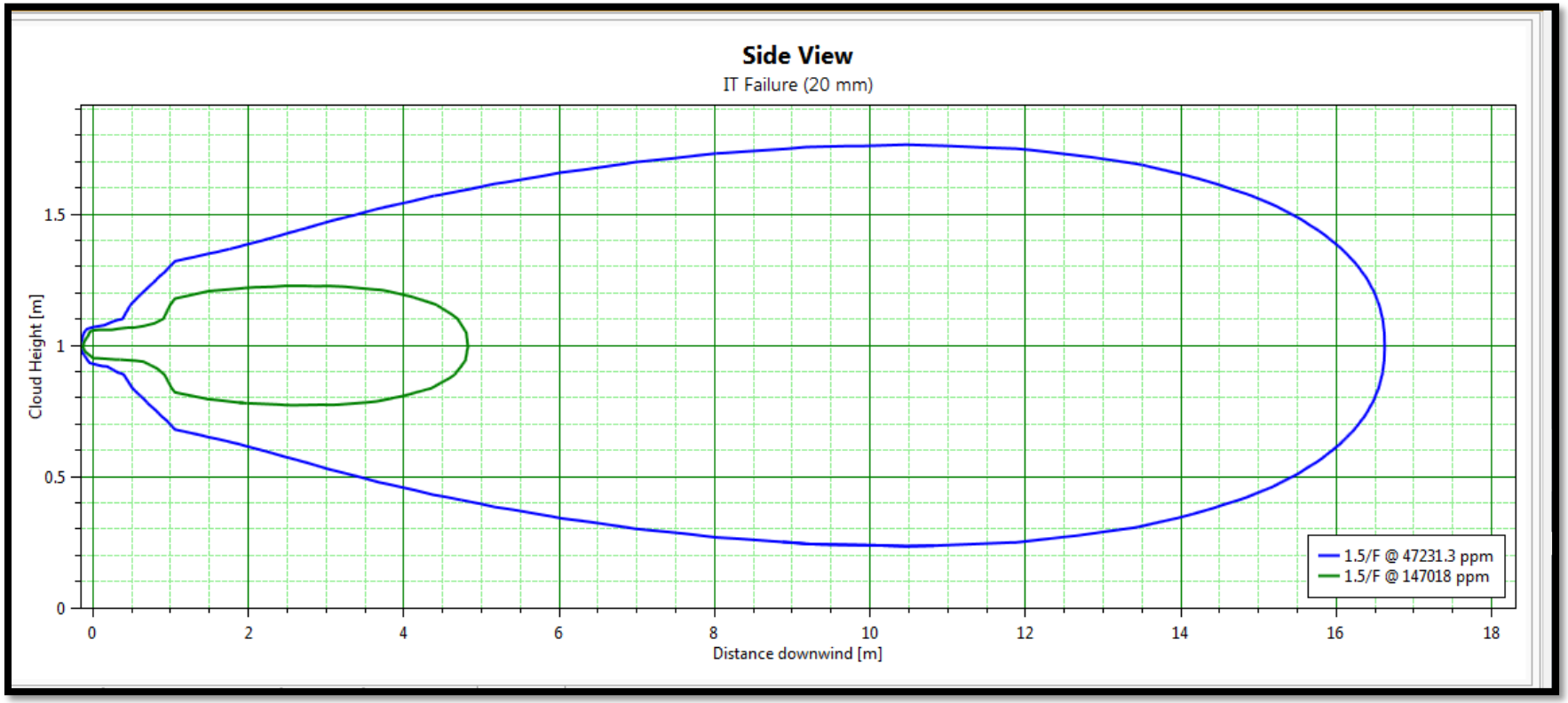


Figure- 7.1.2: 20 mm leak; Jet Fire Distances (m)

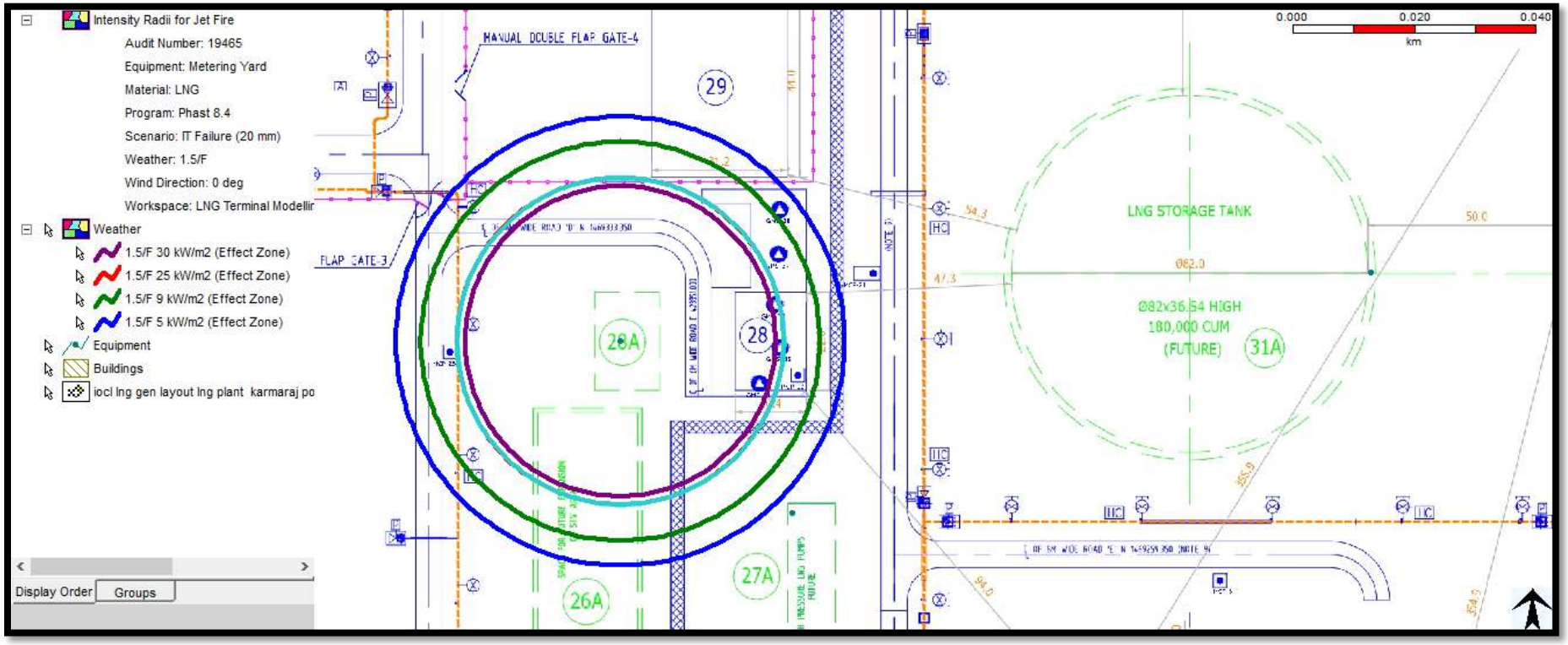
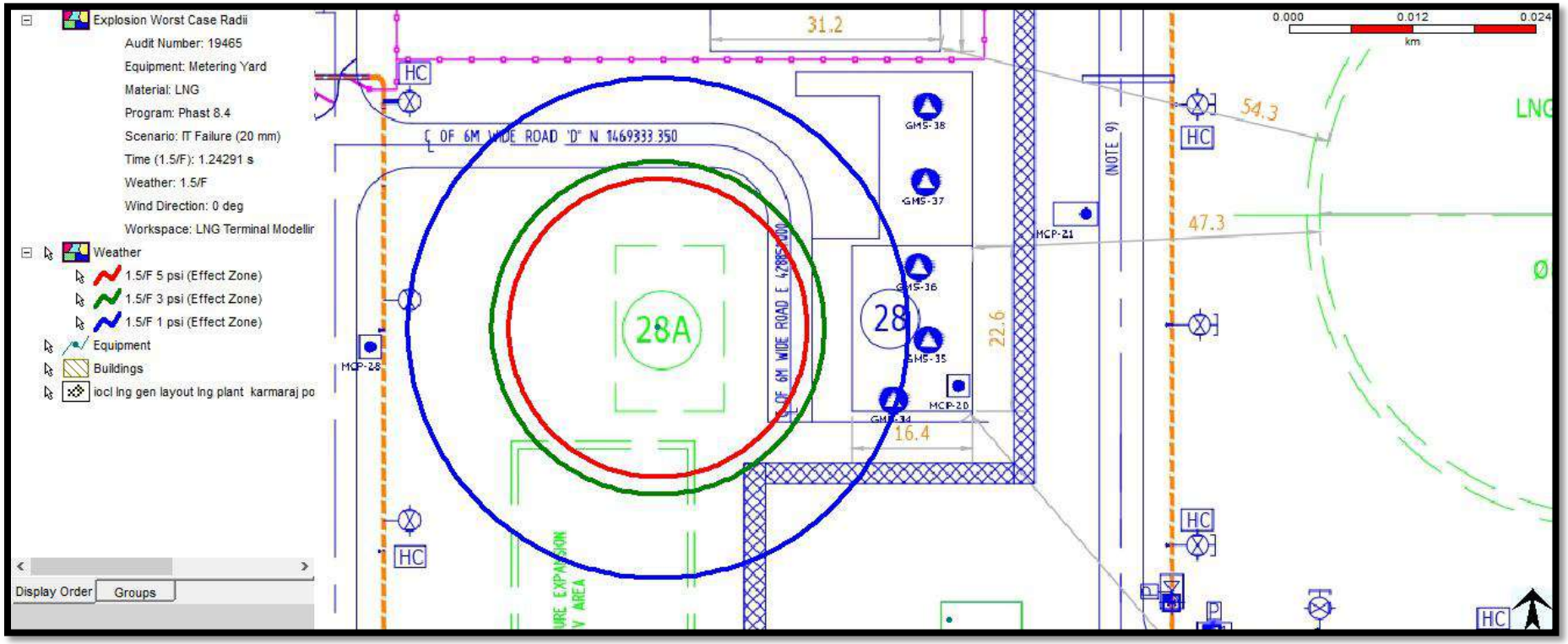


Figure- 7.1.3: 20 mm leak; Blast Overpressure Distances (m)



8. Hot Oil Pump Discharge

Figure- 8.1.1: 20 mm leak; Flash Fire Distances (m)

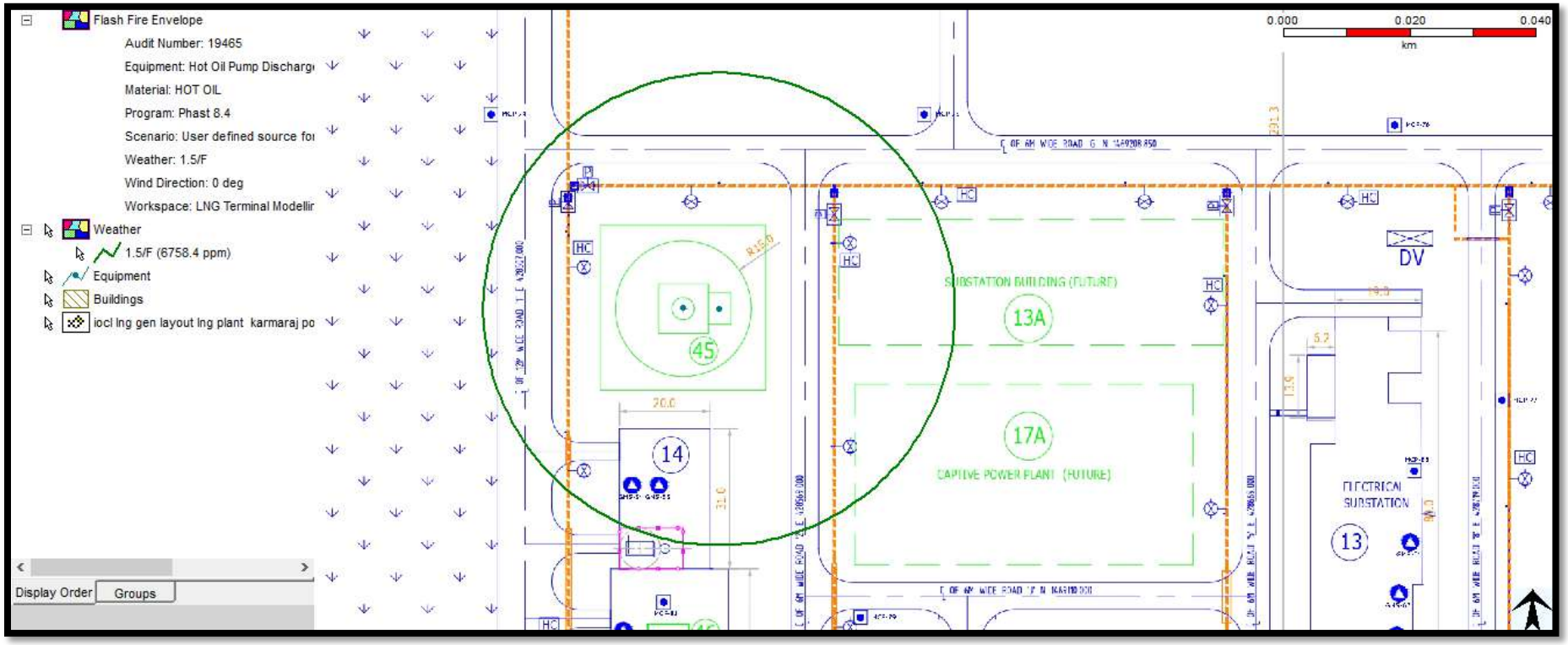


Figure- 8.1.2: 20 mm leak; Jet Fire Distances (m)

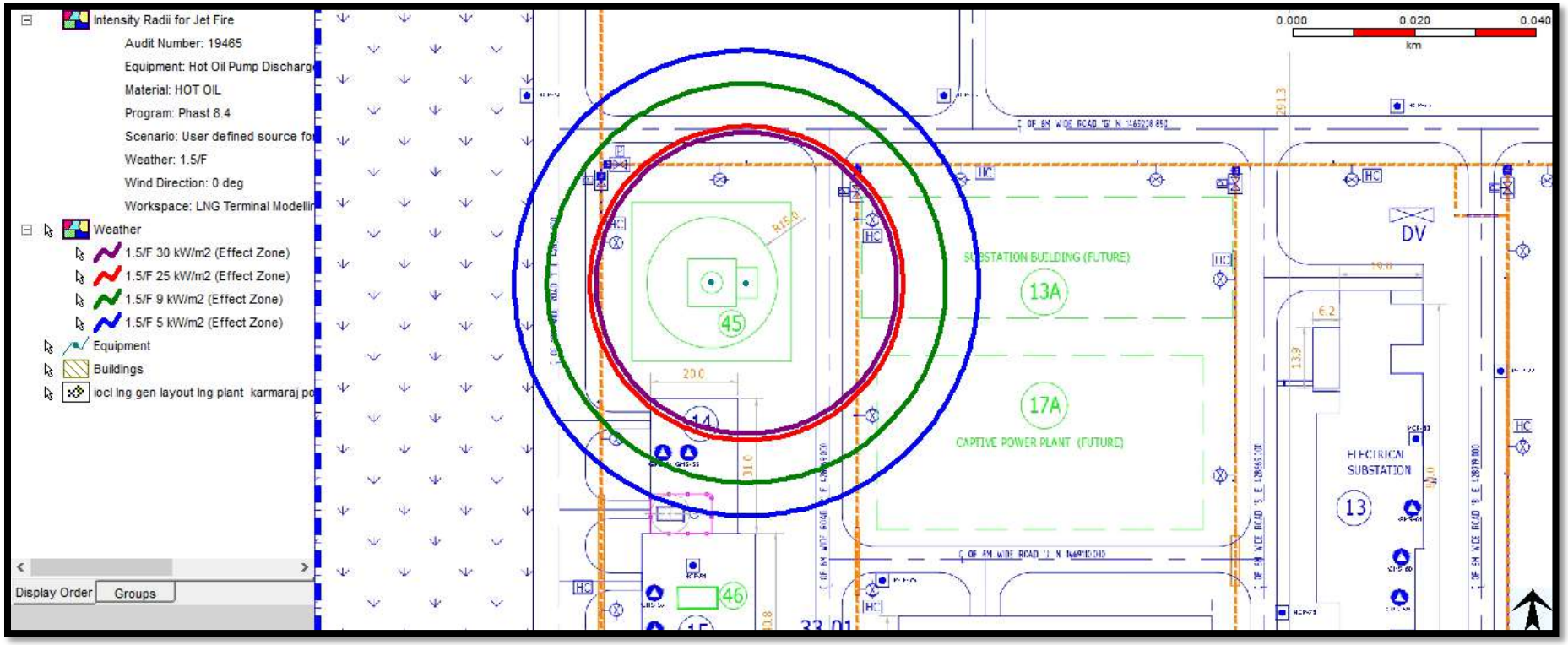


Figure- 8.1.3: 20 mm leak; Blast Overpressure Distances (m)

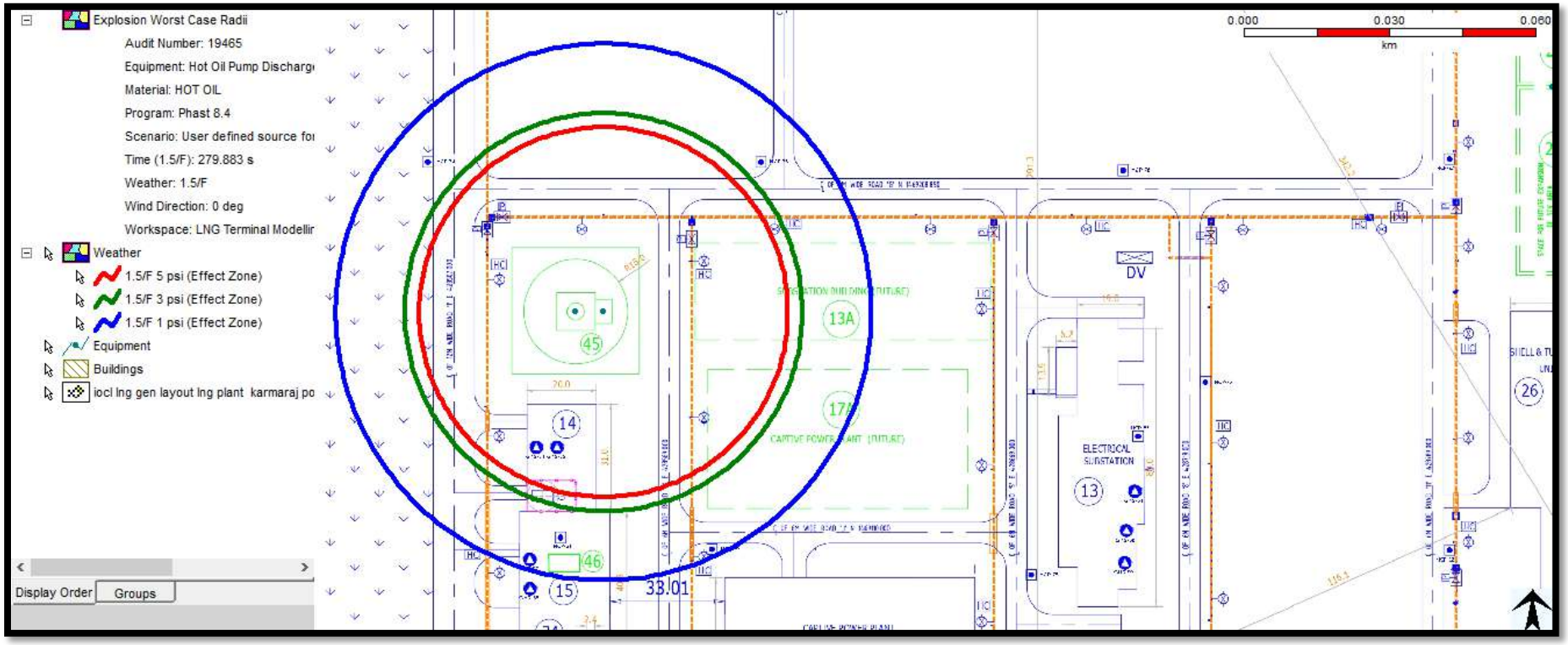
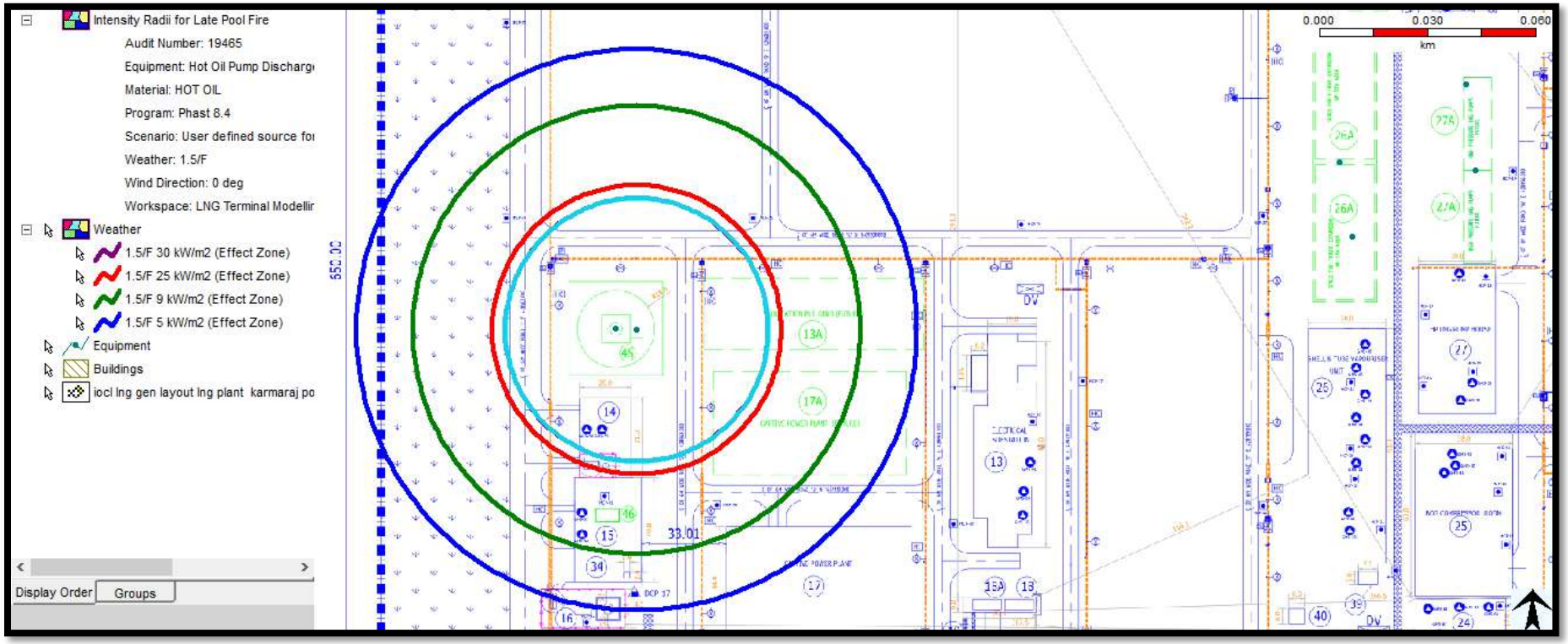
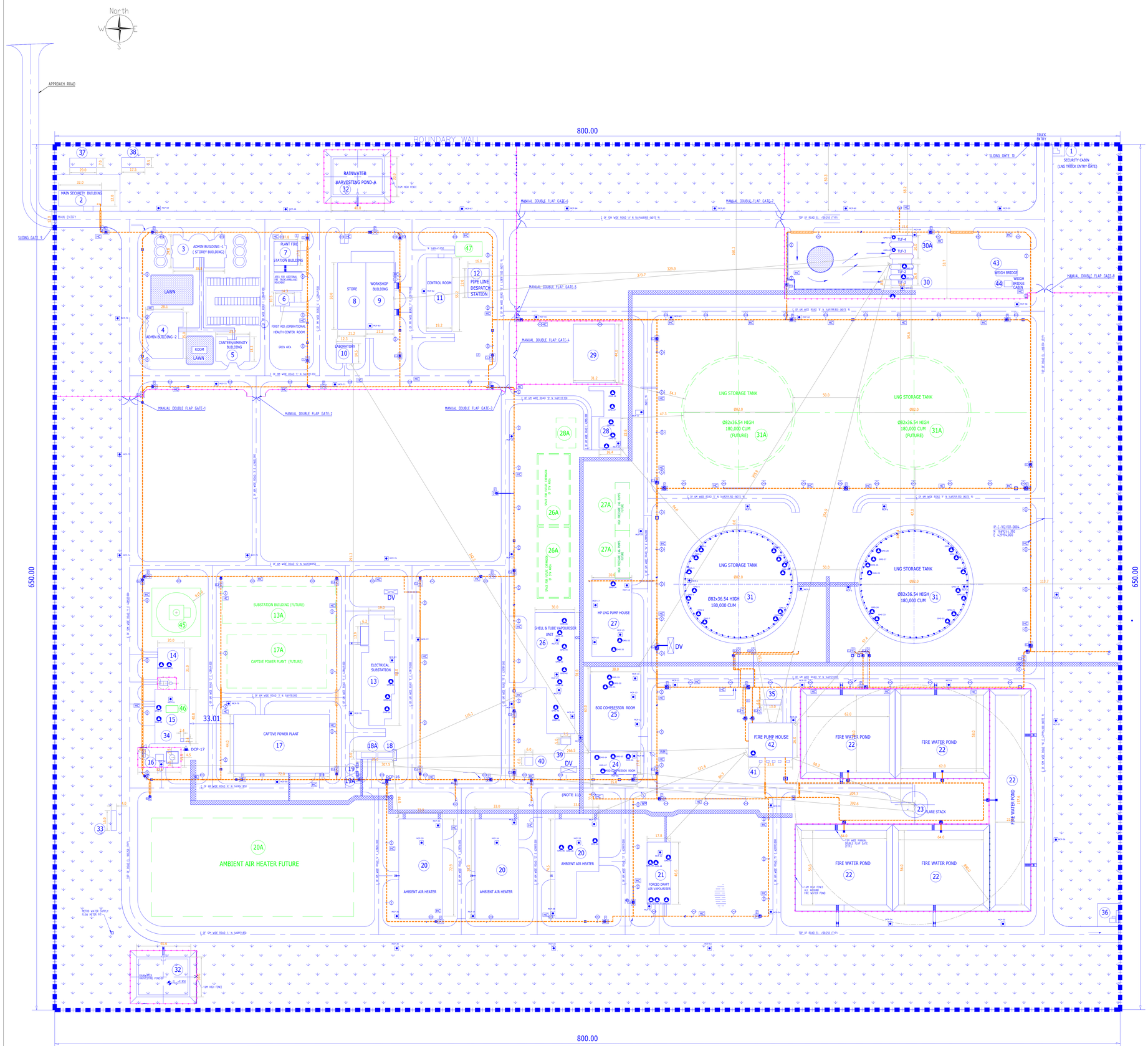


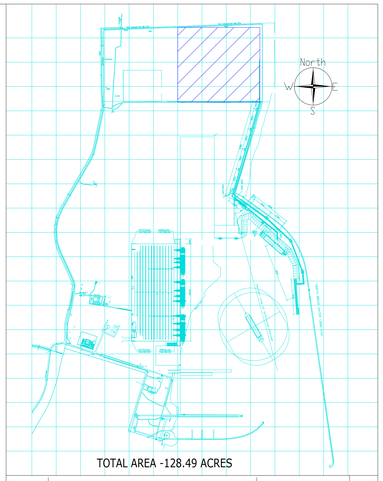
Figure- 8.1.4: 20 mm leak; Pool Fire Distances (m)



ANNEXURE-III

LNG TERMINAL PLOT PLAN





TOTAL AREA -128.49 ACRES

S.NO:	DESCRITION	SIZE	QTY.
1	SECURITY CABIN (LNG TRUCK ENTRY GATE 12M WIDE)	4.2Mx3.3M	1
2	MAIN SECURITY BUILDING	32Mx12M	1
3	ADMIN BUILDING -1 (2 STOREY BUILDING)	30.8Mx24.8M	1
4	ADMIN BUILDING -2	38Mx28.1M	1
5	CANTEEN/AMENITY BUILDING	25.7Mx18.3M	1
6	FIRST AID /OPERATIONAL HEALTH CENTER ROOM	14.3Mx10.2M	1
7	PLANT FIRE STATION BUILDING	17.8Mx17.9M	1
8	STORE	21.2Mx50.0M	1
9	WORKSHOP BUILDING	21.2Mx50.0M	1
10	LABORATORY	12.3Mx14.5M	1
11	CONTROL ROOM	19.2Mx55.2M	1
12	PIPE LINE DESPATCH STATION	16Mx22M	1
13	ELECTRICAL SUBSTATION	80Mx19M	1
13A	PROPOSED ELECTRICAL SUBSTATION	83Mx24.5M	1
14	NITROGEN STORAGE 30KL CAP./ N2 PACKAGE	31Mx20M	1
15	AIR COMPRESSOR HOUSE (3 NOS. OF COMPRESSOR)	40.8Mx26M	1
16	HSD STORAGE INSTALLATION (40KL)	32.4Mx15M	1
17	CAPTIVE POWER PLANT(3 NOS. GEG-9.36 MW EACH)	72Mx44M	1
17A	PROPOSED CAPTIVE POWER PLANT(2 NOS. GTGS)	85Mx45M	2
18	D.G SETS (1000 KVA)	28Mx6.0M	1
18A	D.G SET (750 KVA)	28Mx6.0M	1
19	DAY TANK	900LTS	1
19A	DAY TANK	900LTS	1
20	AMBIENT AIR HEATERS (TOTAL-88 FANS) (2x32FANS & 1x24 FANS)	33Mx75M	3
20A	PROPOSED AMBIENT AIR HEATERS (TOTAL-88 FANS) (2x32FANS & 1x24 FANS)	33Mx75M	3
21	FORCED DRAFT AIR VAPOURISER (30 NOS)	17.8x46.6M	1
22	FIRE WATER POND (58Mx62Mx2Mx4 NOS.)(1576Mx22Mx2Mx1 NO.)	3134B CUM	5
23	FLARE STACK	60M HIGH	1
24	MSO COMPRESSOR ROOM (1NO. COMPRSSOR)	35Mx17M	1
25	BOG COMPRESSOR ROOM (3NOS. OF COMPRESSORS)	33Mx17M	1
26	SHELL & TUBE VAPOURISER UNIT (6 NOS. OF STV UNITS)	91Mx30M	1
26A	PROPOSED SHELL & TUBE VAPOURISER UNIT (6 NOS. OF STV UNITS)	91Mx30M	1
27	HP LNG PUMP HOUSE (5 NOS. OF PUMPS)	58Mx30M	1
27A	PROPOSED HP LNG PUMP HOUSE (5 NOS. OF PUMPS)	58Mx30M	1
28	METERING YARD	22.6Mx16.4M	1
28A	PROPOSED METERING YARD	31.2Mx44.0M	1
29	PIPELINE DESPATCH METERING YARD	44Mx19.2M	1
30	TANK LORRY FILLING STATION (LOADING BAYS-2NOS)	15Mx 16M	1
30A	TANK LORRY FILLING STATION (LOADING BAYS-2 NOS.)	15Mx20M	1
31	LNG STORAGE TANK (180,000 CUM CAPACITY EACH)	82M DIA.x36.5M HIGH	2
31A	PROPOSED LNG STORAGE TANK (180,000 CUM CAPACITY EACH)	82M DIA.x36.5M HIGH	2
32	RAIN WATER HARVESTING POND	40Mx30M	2
33	UTILITY WATER TANK	15MX4M	1
34	COOLING WATER TOWER	2.4x2.5M	1
35	WATER TREAMENT SKID	13Mx6M	1
36	SECURITY CABIN (JETTY GATE)	-	1
37	TWO WHEELER PARKING SHED	20Mx7M	1
38	LABOUR REST ROOM	17.5Mx7.5M	1
39	GLYCOL WATER DRAIN SUMP	5.0Mx7.5M	1
40	IMPOUNDING BASIN	6.0Mx6.0M	1
41	DIESEL DAY TANK 900 LTS. (FOR FIRE PUMPS)	2.0Mx1.3M	5
42	FIRE PUMP HOUSE	33Mx26.0M	1
43	WEIGHT BRIDGE FOR ROAD TANKER	4Mx26M	1
44	WEIGHT BRIDGE CABIN	4.5Mx6.0M	1
45	PROPOSED HOT OIL STORAGE TANK & PUMP AREA	11.0Mx16.0M	1
46	PROPOSED AIR COMPRESSOR	9.0Mx5.0M	1
47	PROPOSED PANEL ROOM FOR DCS	19.0Mx21.5M	1

LEGEND :-

- OUTER BOUNDARY WALL (3M HEIGHT)
- PIPE RACK
- 3MMH CHAIN LINK FENCING (2.8M HEIGHT)
- FIRE WATER LINE
- DOUBLE HYDRANT VALVE
- HOSE BOX
- MANUAL CALL POINT - 86 NOS.
- GAS MONITORING SYSTEM -67 NOS.
- EXISTING
- FUTURE EXPANSION

IndianOil LNG

IndianOil LNG Pvt Ltd

TITLE:

PLAN SHOWING LNG IMPORT, STORAGE & RE-GASIFICATION TERMINAL AND EXPANSION FACILITIES

DRG NO; 19200-0102-8230-01-0201	DATE :05.12.2022	SCALE: I :1000	REV -Z7

ANNEXURE- VI

CRZ STUDY REPORT AND MAPS

Preparation of Local Level CRZ Map for the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu by Superimposing on Approved CZMP as per CRZ Notification 2011

FOR

M/s. Indianoil LNG Private Limited
Level-8, Indianoil Bhavan
139, Nungambakkam High Road
Chennai - 600 034

INSTITUTE OF REMOTE SENSING
ANNA UNIVERSITY, CHENNAI-25

APRIL 2022

PROJECT DATA SHEET

Title: Preparation of Local Level CRZ Map for the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu by Superimposing on Approved CZMP as per CRZ Notification 2011

Project No	:	REF NO. IRS/AU/DTV/15-2022, dt. 24/04/2022
Coordinator	:	Dr. D. Thirumalaivasan, Professor
Done for	:	**M/s. Indianoil LNG Private Limited** **Level-8, Indianoil Bhavan** **139, Nungambakkam High Road** **Chennai - 600 034**
Survey Team	:	Mr. Sathishkumar, IRS, AU and Mr. Sukumar, IRS,AU
Data Processing	:	Mr. J. Prem Kumar
Report Preparation	:	Dr. D. Thirumalaivasan
Quality Check	:	Dr. R. Murugasan, Professor
		Dr. M. Shanmugam, Associate Professor
		Dr. R. Kanmani Shanmuga Priya, Assistant Professor

The quality Assessment of Map and Report has been completed for superimposing of the project boundaries/Layout details (Source: Client/Survey) on HTL/LTL/ESA (Source: Approved CZMP MAP NO: TN 111) by the Quality Assessment team on 27/04/2022.

Dr. D.Thirumalaivasan
(Principal Consultant)

Dr. R. Murugasan
(QA member)

Dr. M. Shanmugam
(QA member)

Dr. R. Kanmani Shanmuga Priya
(QA member)

DIRECTOR

Director
Institute of Remote Sensing
Anna University,
Chennai - 600 025

Executive Summary

On the request of the **M/s. Indianoil LNG Private Limited, Level-8, Indianoil Bhavan, 139, Nungambakkam High Road, Chennai - 600 034** , superimposition of High Tide Line (HTL), Low Tide Line (LTL) as per approved CZMP and preparation of Local Level Coastal Regulation Zone (CRZ) Map, is undertaken for **the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu by Superimposing on Approved CZMP as per CRZ Notification 2011**

The Project Site falls in various CRZ categories such as CRZ - III (200m to 500m from HTL) and Outside CRZ, as per approved CZMP, and the details are indicated in Conclusion.

The HTL, LTL, Ecologically sensitive areas along with setback lines indicated in approved CZMP(Approved CZMP map NO: TN 111) prepared as per CRZ Notification 2011 were superimposed on to georeferenced cadastral map to prepare a local level CRZ map at 1:4,000. The proposed activities in the project area as provided by the client were superimposed on the CRZ map. The co-ordinates of the HTL in WGS84 system are presented in the Annexure-I along with project details superimposed in CZMP map in Annexure II.

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LIST OF FIGURES

1.0 INTRODUCTION

1.1 Coastal Regulation Zone

The coastal zone is the area of interaction between land and sea. The coastal Zone of Tamil Nadu has a very high concentration of population along with ecologically sensitive areas like mangroves. There is a spurt of developmental activities arising from huge residential colonies, new industries and tourism centres along the coast and in coastal zone. There is a need to protect the coastal environment while ensuring continuing production and development. This zone is extremely vulnerable and has to be managed judiciously striking a balance between ecological and developmental needs.

Government of India has issued a notification during February 1991 for regulating the developments along the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action. The land between 500 meters from the High Tide Line (HTL) and the Low Tide Line (LTL) is identified as Coastal Regulation Zone (CRZ). The coastal stretches within CRZ are classified into four categories, namely, Category I (CRZ-I), Category II (CRZ-II), Category III (CRZ-III) and Category IV (CRZ-IV). The notification has also laid down regulations to regulate the various activities in the coastal zone. The Ministry of Environment and Forests, Government of India, has approved a set of CRZ maps on 1:25,000 scale prepared from SPOT satellite imagery. On these maps, zones are demarcated as CRZ I, CRZ II and CRZ III, by Tamil Nadu State CZMA.

Coastal Regulation Zone I includes the zone between High Tide Line and Low Tide Line. It also includes the areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests,

wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as may be declared by the Central Government or the concerned authorities at the State/Union Territory level from time to time.

CRZ-II covers the areas that have already been developed up to or close to the shoreline. For this purpose, the "developed area" is referred to as that area within the municipal limits or in other legally designated urban areas which are already substantially built up and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains. CRZ-III covers the areas that are relatively undisturbed and those which do not belong to either Category-I or II. These include the coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas which are not substantially built up. CRZ-IV refers to the coastal stretches in the Andaman and Nicobar, Lakshadweep and small islands other than those designated as CRZ-I, CRZ-II or CRZ-III.

The Ministry of Environment and Forest in the CRZ Notification, 2011 declared the following areas as CRZ and imposed with effect from the date of the notification the restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ. The areas that are defined as CRZ as per CRZ Notification, 2011 are

(i) The land area from High Tide Line (HTL) to 500mts on the landward side along the sea front.

(ii) CRZ shall apply to the land area between HTL to 100 meters or width of the creek whichever is less on the landward side along the tidal influenced

water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance upto which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans.

(iii) The land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and through the Survey of India taking into account tides, waves, sea level rise and shoreline changes.

(iv) Land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

(v) The water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The Classification of the CRZ is also modified for the purpose of conserving and protecting the coastal areas and marine waters as CRZ – I, CRZ – II, CRZ – III and CRZ – IV. The CRZ – I include the areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast like (a) Mangroves(b) Corals and coral reefs and associated biodiversity (c) Sand Dunes (d) Mudflats which are biologically active (e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas (f) Salt Marshes (g) Turtle nesting grounds (h) Horse shoe crabs habitats (i) Sea grass beds (j) Nesting grounds of birds (k) Areas or

structures of archaeological importance and heritage sites and the area between Low Tide Line and High Tide Line. The CRZ-II includes areas that have been developed upto or close to the shoreline. The CRZ-III includes areas that are relatively undisturbed and those do not belong to either CRZ-I or II, which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up. The CRZ-IV includes the water area from the Low Tide Line to twelve nautical miles on the seaward side and the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year. The Ministry of Environment and Forest has also provided guidelines for demarcation of High Tide Line in the CRZ Notification, 2011. As per the guidelines, Cadastral (village) maps in 1:3960 or the nearest scale shall be used as the base maps. HTL and LTL will be demarcated in the cadastral map based on detailed physical verification using coastal geomorphological signatures or features in accordance with the CZM Maps approved by the Central Government. 500metre and 200metre lines shall be demarcated with respect to the HTL.

In order to facilitate classification of Coastal Regulation Zones Government of India has approved few agencies/institutions across the Country vide Lr. No. J17011/8/92-1A III, dated 10.05.1999 of Ministry of Environment and Forests. Institute of Remote Sensing, Anna University being one of them, has been carrying out preparation of local level CRZ Map for the proposed projects at 1:4,000 scale following the guidelines issued by Ministry of Environment & Forests, Government of India.

1.2 BACKGROUND

M/s. Indianoil LNG Private Limited, Level-8, Indianoil Bhavan, 139, Nungambakkam High Road, Chennai - 600 034, has requested Institute of Remote Sensing, Anna University to superimpose HTL, LTL and prepare CRZ Map, as per approved CZMP, for the Sea/Bay/tidal influenced water bodies and ecologically sensitive areas on 1:4,000 scale in the vicinity of their **Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu by Superimposing on Approved CZMP as per CRZ Notification 2011**. The proposed project activities have proximity to the Sea/ Tidal Influenced Water body. It is in this context, the proposed activities needs to be evaluated to assess whether the activities falls under regulations of CRZ Notification, 2011. Hence IRS has taken up a ground GPS survey for superimposition of HTL, LTL and ecologically sensitive areas indicated in approved CZMP for preparation of local level CRZ Map.

1.3 OBJECTIVES

The objective of the present study is to examine the **Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu,** with reference to CRZ Notification, 2011. Keeping in view of the requirements of CRZ notification, Institute of Remote Sensing, Anna University under took the project with following agreed scope of work:

- Identification of HTL, LTL indicated in approved CZMP near proposed project activities by conducting field survey using DGPS survey.
- Mapping of ecologically sensitive entities such as Mangroves, Turtle breeding grounds, etc., indicated in approved CZMP near project site

- Superimposition of HTL,LTL, Ecologically Sensitive Areas along with project layout details on to the georeferenced cadastral map
- Preparation of Coastal Regulation Zones by mapping setback lines as per CRZ Notification from HTL in the vicinity of project site.

1.4 Equipment

CZMP prepared as per CRZ Notification 2011 and approved by MOEF, New Delhi were used as reference and superimposition of project site activities based on reference points identified by the client in the field, by GNSS Survey. In addition, HTL, LTL from the approved CZMP was superimposed to prepare CZMP.

2.0 STUDY AREA

2.1 Description of Study Area

The Project Site of **Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu.**

2.2 Status as per Approved CZMP

The Project Site falls in various CRZ categories such as CRZ - III (200m to 500m from HTL) and Outside CRZ, as per approved CZMP, approved by MOEF, Government of India, New Delhi published by Tamil Nadu state CZMA(TN MCZMA) in the year 2018.

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3.0 RESULTS AND CONCLUSIONS

3.1 Results

The processed HTL co-ordinates in WGS 84 system and project site coordinates are presented at Annexure I. The **Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu, falls in various CRZ categories such as CRZ - III (200m to 500m from HTL) and Outside CRZ, as per approved CZMP,** approved by MOEF, Government of India, New Delhi published by Tamil Nadu state CZMA(TNCZMA) in the year 2018. The various CRZ Categories and their statistics are shown in Table 1.

Table 1 Various CRZ Categories of Project Layout Details

Sl.No.	CRZ - Classification	Area in Sq.m
1	CRZ - III (200m to 500m from HTL)	112338.32
2	Outside CRZ	407454.69
	Total	519793.01

The approved CZMP(Map No : TN 111) as Fig. 1 in Annexure II, satellite imagery (Fig. 2 in Annexure III) and Local Level CRZ Map (Fig 3 in Annexure IV) of project site are enclosed.

3.2 Conclusions

In this case, the **Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu, falls in various CRZ categories such as CRZ - III (200m to 500m from HTL) and Outside CRZ, as per approved CZMP,** approved by MOEF, Government of India, New Delhi published by Tamil Nadu state CZMA in the year 2018. **Two copies of Local level CRZ Maps(1: 4000), Index Map with number: IRS/AU/DTV/15-2022, dt. 24/04/2022, are attached with this report along with 7 Km 1:25000 Scale CRZ Map.**

PRINCIPAL CONSULTANT **DIRECTOR, IRS**

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ANNEXURE I
COORDINATES OF HTL REFERENCE POINTS
Reference System: WGS 84 Datum

HTL Pt	Latitude	Longitude
1	13° 18' 2.469" N	80° 20' 48.077" E
2	13° 17' 50.314" N	80° 20' 50.290" E
3	13° 17' 45.141" N	80° 21' 1.612" E
4	13° 17' 29.092" N	80° 20' 55.926" E
5	13° 17' 13.351" N	80° 20' 51.175" E
6	13° 17' 1.230" N	80° 20' 47.742" E
7	13° 17' 3.730" N	80° 19' 47.430" E
8	13° 17' 20.337" N	80° 19' 49.688" E
9	13° 17' 39.013" N	80° 19' 49.335" E
10	13° 17' 54.643" N	80° 19' 49.313" E

PROJECT PLANT SITE COORDINATES
Reference System: WGS 84 Datum

LABEL	LATITUDE	LONGITUDE
A	13° 17' 39.793" N	80° 20' 16.493" E
B	13° 17' 39.859" N	80° 20' 43.081" E
C	13° 17' 18.714" N	80° 20' 43.138" E
D	13° 17' 18.638" N	80° 20' 16.550" E

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ANNEXURE II

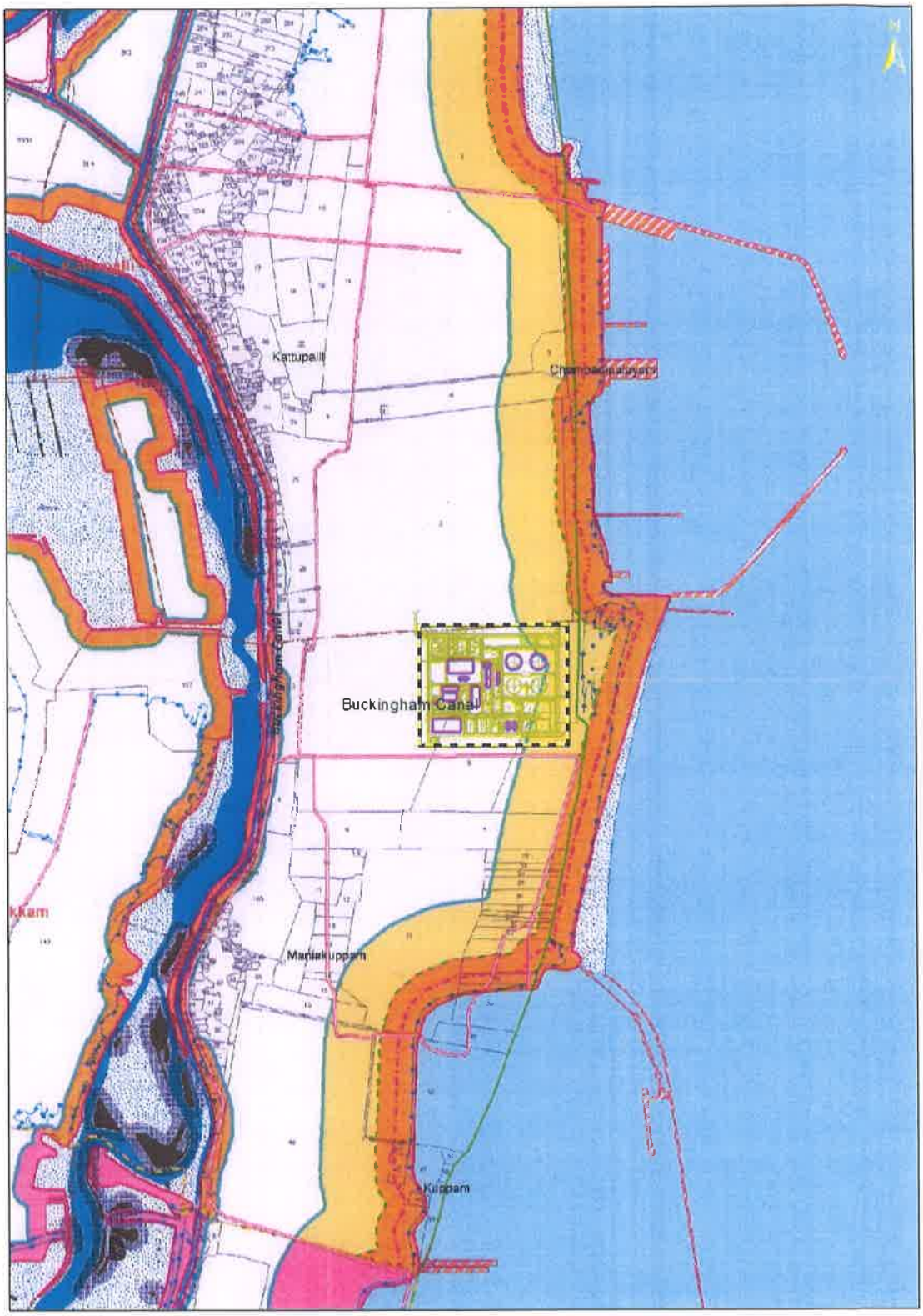


Fig 1 . Approved CZMP with Project Site Superimposed

ANNEXURE III

Fig 2. Satellite Imagery of Project Site (Source: Google Earth)

ANNEXURE IV

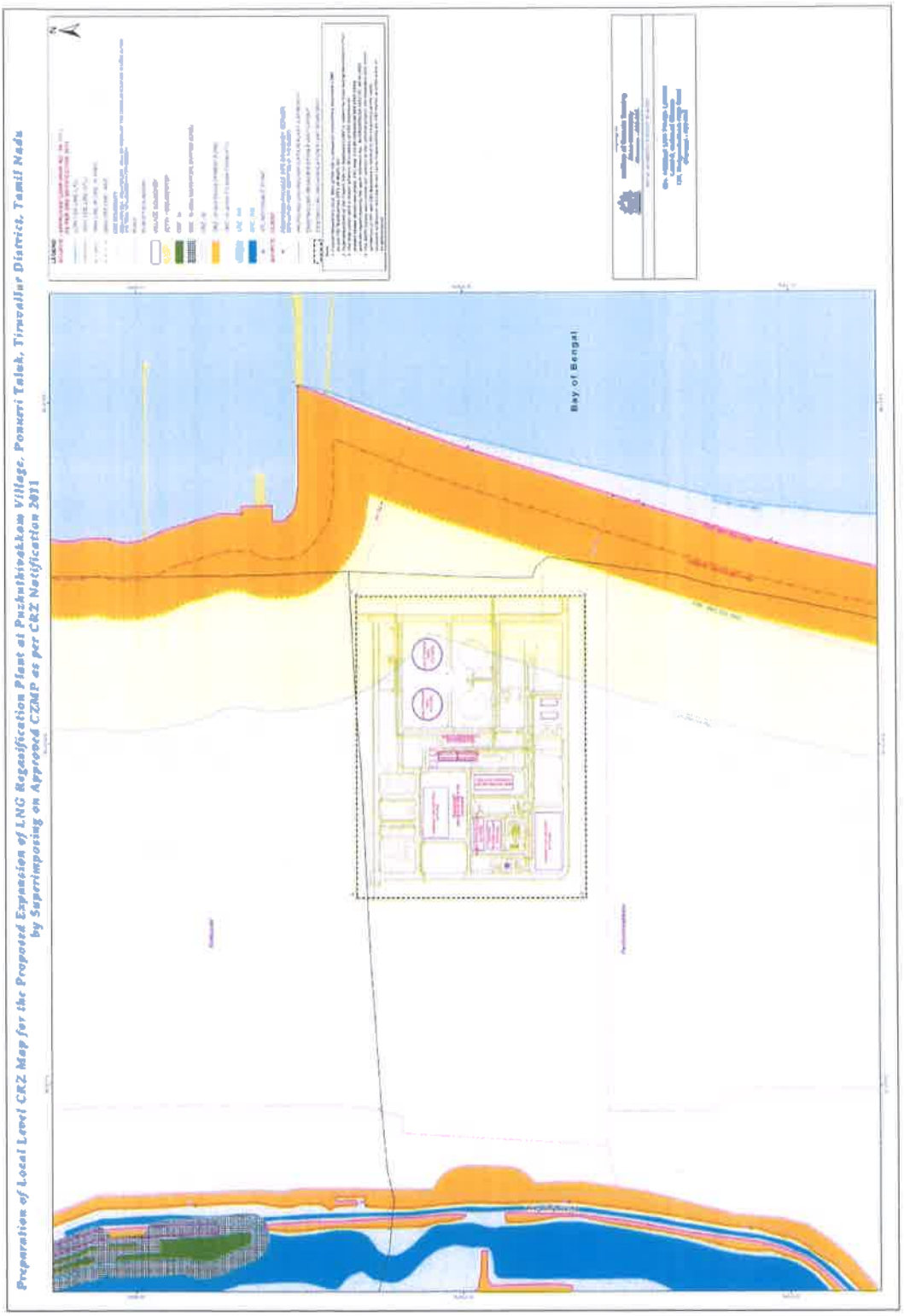
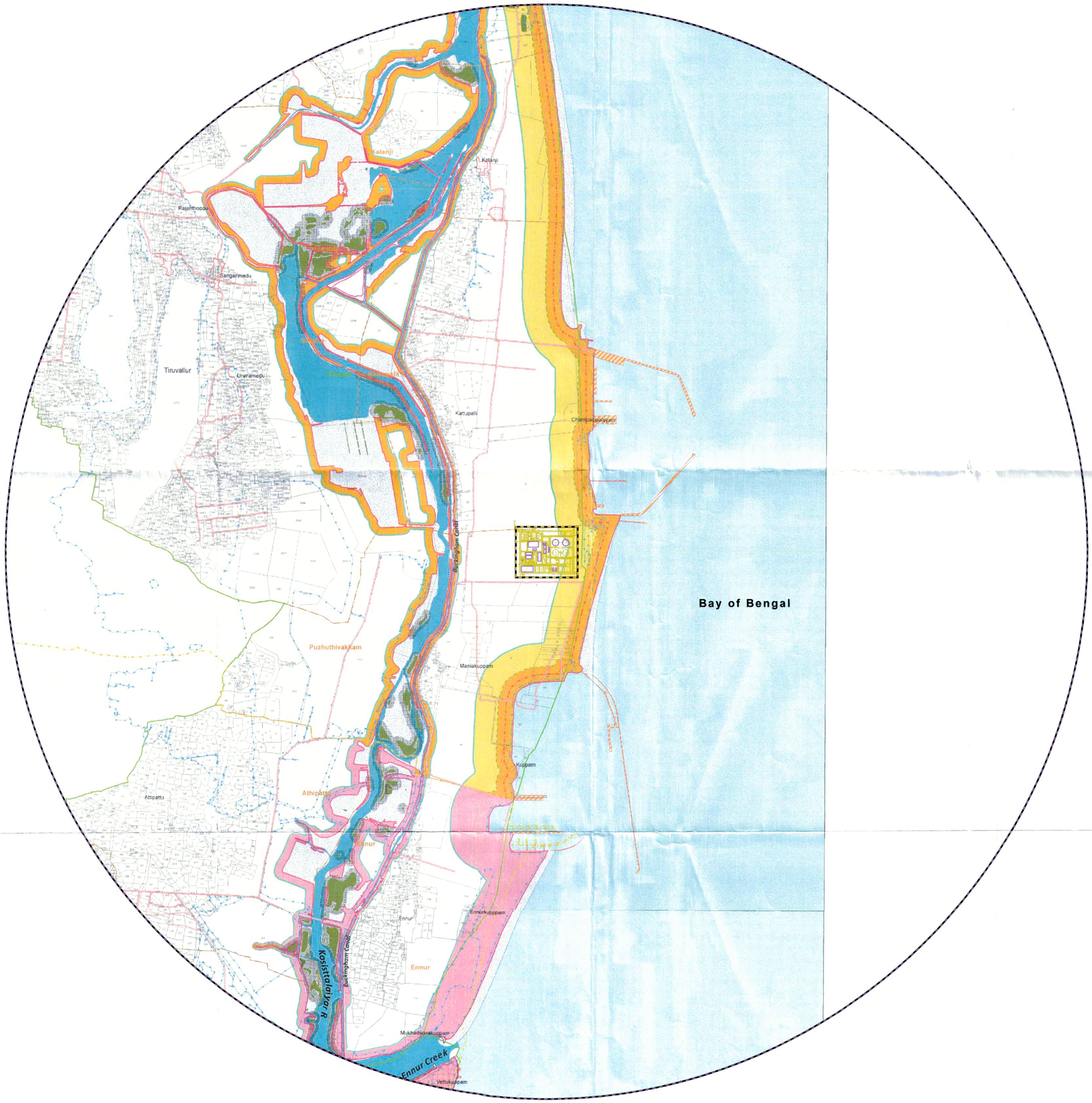


FIG 3. LOCAL LEVEL CRZ MAP

Superimposing the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu on Approved CZMP as per CRZ Notification 2011 for 7Km Radius



N

LEGEND

SOURCE : APPROVED CZMP (MAP NO : TN 110 & 111) AS PER CRZ NOTIFICATION 2011

- LOW TIDE LINE (LTL)
- HIGH TIDE LINE (HTL)
- 100m LINE IN CRZ - III AREA
- 200m CRZ LINE - NDZ
- CRZ BOUNDARY (500m FOR SEA, 100m FOR BAY, 100m OR WIDTH OF THE CREEK WHICHEVER IS LESS ALONG THE TIDAL INFLUENCED WATER BODIES)
- ROAD
- SURVEY BOUNDARY
- VILLAGE BOUNDARY
- TALUK BOUNDARY
- FISHERMAN SETTLEMENT
- JETTY OR BREAKWATER
- CRZ - IA
- CRZ - IA (50m MANGROVE BUFFER ZONE)
- CRZ - IB
- CRZ - II
- CRZ - III (NO DEVELOPMENT ZONE)
- CRZ - III (200m TO 500m FROM HTL)
- CRZ - IVA
- CRZ - IVB

SOURCE : CLIENT

- PROPOSED PROJECT SITE BOUNDARY CORNER (GPS SURVEY POINT IDENTIFIED BY THE CLIENT)
- PROPOSED LNG REGASIFICATION PLANT EXPANSION
- EXISTING LNG REGASIFICATION PLANT LAYOUT
- EXISTING LNG REGASIFICATION PLANT BOUNDARY
- 7Km BUFFER FROM THE PROJECT SITE

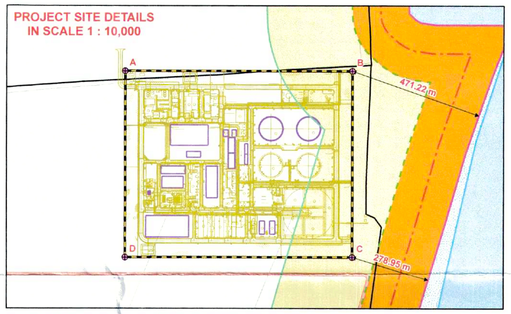
Note:

1. *Coastal Regulation Zone Map of the site is prepared considering Approved CZMP as per CRZ Notification 2011 of MoEF, GoI*
2. *Superimposition of the Project Site on Approved CZMP is subject to scale and generalisation error*
3. *The map comes with a report wherein description of CRZ zonation of project layout details are given. This map is to be referenced and used along with the report bearing the same reference no: AU/IRS/DTV/15-2022 DT. 20.04.2022*
4. *The DGPS Survey was carried out specific to the referred project site boundary only hence, validation of HTL and CRZ Boundary is limited to the clearance of the same. Institute of Remote Sensing do not carry responsibility for CRZ status of other plots or neighbourhood.*

SCALE 1 : 25,000

0 312.5 625 1,250 1,875 2,500 M

PROJECT SITE DETAILS IN SCALE 1 : 10,000



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REF NO. AU/IRS/DTV/15-2022 DT. 20.04.2022

FOR

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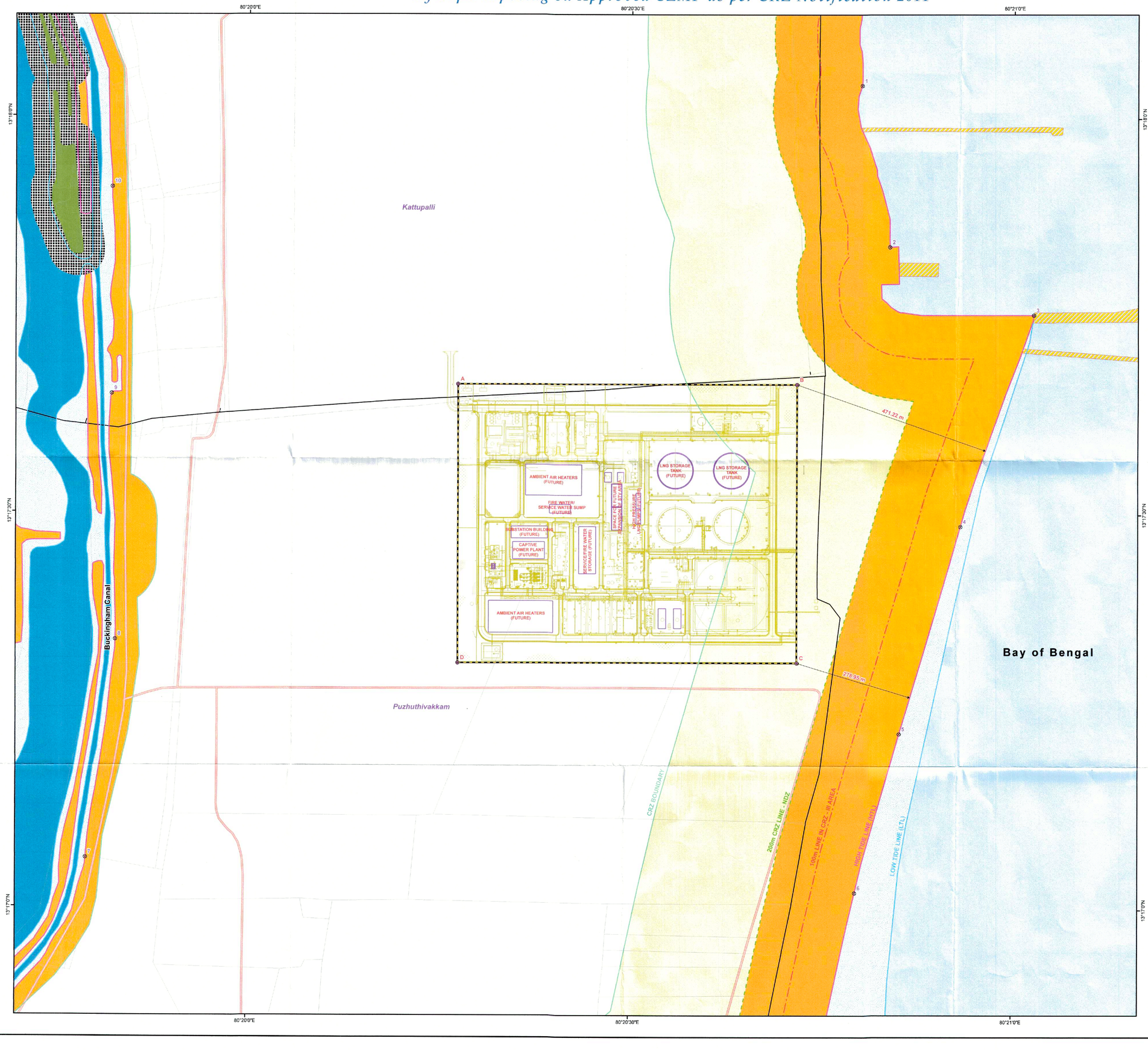
LEVEL-8, INDIANOIL BHAVAN
139, NUNGAMBAKKAM HIGH ROAD
CHENNAI - 600 034

PREPARED BY	
VERIFIED BY	
APPROVED BY	Prof. D. Thirumalaivasan, B.E.M.Tech, Ph.D., Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

Preparation of Local Level CRZ Map for the Proposed Expansion of LNG Regasification Plant at Puzhuthivakkam Village, Ponneri Taluk, Tiruvallur District, Tamil Nadu by Superimposing on Approved CZMP as per CRZ Notification 2011



LEGEND

SOURCE : APPROVED CZMP (MAP NO. TN 111) AS PER CRZ NOTIFICATION 2011

- LOW TIDE LINE (LTL)
- HIGH TIDE LINE (HTL)
- 100m LINE IN CRZ - III AREA
- 200m CRZ LINE - NDZ
- CRZ BOUNDARY (500m FOR SEA, 100m FOR BAY, 100m OR WIDTH OF THE CREEK WHICHEVER IS LESS ALONG THE TIDAL INFLUENCED WATER BODIES)
- ROAD
- SURVEY BOUNDARY
- VILLAGE BOUNDARY
- JETTY / BREAKWATER
- CRZ - IA
- CRZ - IA (50m MANGROVE BUFFER ZONE)
- CRZ - IB
- CRZ - III (NO DEVELOPMENT ZONE)
- CRZ - III (200m TO 500m FROM HTL)
- CRZ - IVA
- CRZ - IVB
- HTL REFERENCE POINT

SOURCE : CLIENT

- PROPOSED PROJECT SITE BOUNDARY CORNER (GPS SURVEY POINT IDENTIFIED BY THE CLIENT)
- PROPOSED LNG REGASIFICATION PLANT EXPANSION
- EXISTING LNG REGASIFICATION PLANT LAYOUT
- EXISTING LNG REGASIFICATION PLANT BOUNDARY

Note:

1. ***Coastal Regulation Zone Map of the site is prepared considering Approved CZMP as per CRZ Notification 2011 of MoEF, GoI***
2. ***Superimposition of the Project Site on Approved CZMP is subject to scale and generalisation error***
3. ***The map comes with a report wherein description of CRZ zonation of project layout details are given. This map is to be referenced and used along with the report bearing the same reference no: AU/IRS/OTV/15-2022 DT. 20.04.2022***
4. ***The DGPS Survey was carried out specific to the referred project site boundary only hence, validation of HTL and CRZ Boundary is limited to the clearance of the same. Institute of Remote Sensing do not carry responsibility for CRZ status of other plots or neighbourhood.***

N

SCALE 1 : 4,000

0 50 100 200 300 400 M

Prepared By

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REF NO. AU/IRS/OTV/15-2022 DT. 20.04.2022

For

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PREPARED BY	
VERIFIED BY	
APPROVED BY	Prof. D. Thirumalaivasan, B.E.M.Tech.,Ph.D., Director, Institute of Remote Sensing, Anna University, Chennai-600 025.

पंजीकृत कार्यालय : इंजीनियर्स इंडिया भवन, 1, भीकाएजी कामा प्लेस, नई दिल्ली-110066
Regd. Office : Engineers India Bhawan, 1, Bhikaiji Cama Place , New Delhi – 110066