

EXECUTIVE SUMMARY

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

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Project Proponent:



IndianOil LNG Private Limited
(IOLPL)

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

Environmental Consultant:



Engineers India Limited

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

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

1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL), 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 and 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 beyond 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 storage and Regasification facility

In this regard, IOLPL submitted proposal to MOEF&CC (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 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”.

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 from the date of board approval

1.1 EXISTING FACILITIES AT ENNORE LNG TERMINAL

This existing terminal receives imported LNG through LNG carriers / ships at a dedicated LNG Berth 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 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°C.

1.2 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 existing BOG Compressors and 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.

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 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.

2.0 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 Socio-economic and Biological environment is summarized here.

2.1 Air Environment

Ambient air quality monitoring has been carried out at 8 nos. locations. PM₁₀, PM_{2.5}, SO₂, 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-1**.

Table - 1 Summary of Baseline data of AAQs

Particular	98 th Percentile value	NAAQ Standard
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.

2.2 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 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.

2.3 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.

2.4 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.

2.5 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*, *Lanea coromandolica*, *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 rhynchops* 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.

2.6 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, 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%.

3.0 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-2**.

Table-2: Impact Identification Matrix

Activities	Physical				Biological		Socio-economic	
	Ambient air quality	Ground / surface water (quantity / quality)	Ambient noise	Land (land use, topography & drainage, soil)	Flora	Fauna	Livelihood & occupation	Infrastructure
CONSTRUCTION PHASE								
Site preparation	*		*	*	*	*	*	
Civil works	*		*			*		
Heavy equipment operations	*		*					
Disposal of construction wastes				*	*	*		
Generation/disposal of sewerage		*		*				
Transportation of materials	*		*					
OPERATION PHASE								

Commissioning of Process units, utilities and offsite	*	*	*					
Product handling and storage	*							
Emissions & Waste management – Air, liquid and solid waste	*	*		*				

Impacts have been assessed considering spatial, temporal, intensity and vulnerability scales and its overall significance value is given in **Table -3**.

Table-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

4.0 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

4.1 AIR ENVIRONMENT

Construction Phase

Impacts (Significance - Low)

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

Mitigation Measures

- Ensuring preventive maintenance of vehicles and equipment.

- Ensuring vehicles with valid Pollution under Control certificates are used.
- 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 PM_{2.5} from the proposed project. Only small quantity of NO_x emission is envisaged due to combustion of gaseous fuel in GTG.
- The resultant NO_x 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.

4.2 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 of Sewage, grey water from site area and washing water for vehicle and equipment maintenance area.

Mitigation Measures

- Monitoring water usage at work sites to prevent wastage.

Operation Phase

Impacts (Significance –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.

4.3 NOISE ENVIRONMENT

Construction Phase

Impacts (Significance –Low)

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

Mitigation Measures

- Ensuring preventive maintenance of equipments and vehicles.
- 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.

4.4 LAND ENVIRONMENT

Construction Phase

Impacts (Significance –Low)

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

Mitigation Measures

- Restricting all construction activities inside the project boundary.
- Ensuring 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.

4.5 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.

4.6 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 to generate 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 turning requirements of certain vehicles/machineries that might increase congestion and traffic hazards.
- Consolidating deliveries of materials and personnel to project sites, whenever feasible, to minimize flow of traffic.
- Minimizing interruption of access to community for use of public infrastructure
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Preventing use of drugs and alcohol in project-sites
- Preventing possession of firearms by project-personnel, except those responsible for security.

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.

5.0 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-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-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

6.0 ADDITIONAL STUDIES

6.1 RAPID RISK 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. 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.

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/m² and 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/m² is 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/m² 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: 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/m² 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): 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/m² 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: 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/m² 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: 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.

6.2 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 dated 17th September, 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 its 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.

6.3 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 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.

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 georeferenced 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-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

7.0 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.

8.0 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.