

Prefeasibility Report for Proposed LNG Terminal in the Industrial Zone of Haldia Dock Complex at Haldia, West Bengal



ULTRA LNG HALDIA LIMITED

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Prefeasibility Report for Proposed Floating LNG Terminal at Haldia

A consortium of Essar Ports Limited, Ultra LNG Limited and Essar Shipping Limited have been awarded land of ~ 40468.55 m² or 10 acres in the Industrial Zone of Haldia Dock Complex at Haldia on “as is where is” basis for setting up LNG terminal with storage & distribution facilities. For developing the project, an SPV company (Ultra LNG Haldia Limited) has been created.

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1 LIST OF KEY ABBREVIATIONS

Item	Description
ALARP	As low as reasonable practicable
BOG	Boil Off Gas
CGD	City Gas Distribution
CCOE	Chief Controller Of Explosives
GAIL	Gas Authority of India Limited
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
MMSCFD	Million Metric Standard Cubic Feet Per Day
MMSCMD	Million Metric Standard Cubic Meter Per Day
MTPA	Million Tonnes Per Annum
MoEF	Ministry of Environment and Forests
MW	Mega Watt
ONGC	Oil and Natural Gas Corporation
PNG	Piped Natural Gas
PNGRB	Petroleum and Natural Gas Regulatory Board
PESO	Petroleum and Explosives Safety Organisation (PESO)
RLNG	Regasified Liquefied Natural Gas
SCM	Standard Cubic Metre

2 EXECUTIVE SUMMARY

2.1 INTRODUCTION

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane. It is one of the cleanest, safest, and most useful forms of energy in our day-to-day lives. It is an important source of energy for power generation, industrial fuel requirements, feed for the fertilizer and also used as process material for various industries like steel plant and petroleum refineries. India has consumed approx.152 MMSCMD of natural gas in 2016-17 (April to February) out of which approx. 68 MMSCMD was imported in the form of Liquefied Natural Gas (LNG). Bombay High is the main source of domestic natural gas.

Haldia Port is in close proximity to Industrial regions in Central and Eastern India and its hinterland includes major industries which are consumers of LNG such as IOCL, South Asian Petrochemicals Ltd., Haldia Petrochemicals, Matix Fertilizer and Chemicals Ltd.

As there are no LNG import terminals and no pipeline connectivity for gas distribution in eastern India, there is a strong need to develop an LNG import, storage, distribution and bunkering terminal in the Industrial Zone of Haldia Dock Complex at Haldia with road evacuation facilities to cater to LNG demand of the hinterland by delivery via road tankers. Considering the attractiveness of the location, huge untapped gas demand of nearby industries and fall in LNG prices, there is a strong case for development of a new LNG import, Storage and Distribution terminal in the Industrial Zone of Haldia Dock Complex at Haldia. To tap these excellent opportunities, Ultra LNG Haldia Limited (SPV Company) proposes to develop a LNG import, storage, distribution, and bunkering terminal in the Industrial zone of Haldia Dock Complex at Haldia.

The project will primarily include the development of LNG terminals at existing oil jetty (HOJ-1), Outer Terminal 2 (OT-2, which is currently under construction) and barge jetty, loading arms, storage facilities, regasification facilities, evacuation facilities (pipeline and road gantry facilities) and ancillary works.

2.2 PROJECT BRIEF

The consortium has received offer for allotment of KoPT land of ~ 40468.55 m² or 10 acres in the Industrial Zone of Haldia Dock Complex at Haldia on “as is where is” basis for setting up LNG terminal with storage & distribution facilities.

Ultra LNG Haldia Limited proposes to develop a LNG import, storage and distribution facilities in the Industrial Zone of Haldia Dock Complex at the allotted land parcel:

- LNG will be received at the existing oil jetty (HOJ-1) and new liquid jetty under construction named Outer Terminal 2 (OT-2) via LNG vessels
- Storage facilities of ~ 40,000 cbm capacity will be developed which will comprise of storage tanks/bullets/ iso-containers at industrial zone of Haldia Dock Complex of Kolkata Port Trust (KoPT).
- Marine loading arms, marine fixtures and firefighting facilities will be developed at the jetties
- Cryogenic pipelines will be developed for transfer of LNG from Jetties to storage facilities

- Road Gantry facilities will be developed for transport of LNG in iso-containers/tank trailers to end customers
- Cryogenic Pipeline will also be developed for transport of LNG from storage facilities to Barge Jetty for bunkering or loading of LNG into small LNG vessels.
- When the terminal gets connected via gas pipeline, LNG imported via LNG vessels will be stored and regasified into NG and then transported to end customer on the pipeline grid.

3 INTRODUCTION

3.1 NEED FOR THE PROJECT

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane. It is one of the cleanest, safest, and most useful forms of energy in our day-to-day lives. It is an important source of energy for power generation, industrial fuel requirements, feed for the fertilizer and also used as process material for various industries like steel plant and petroleum refineries. India has consumed approx.152 MMSCMD of natural gas in 2016-17 (April to February) out of which approx. 68 MMSCMD was imported in the form of Liquefied Natural Gas (LNG). Bombay High is the main source of domestic natural gas.

Haldia Port is in close proximity to Industrial regions in Central and Eastern India and its hinterland includes major industries which are consumers of LNG such as IOCL, South Asian Petrochemicals Ltd., Haldia Petrochemicals, Matix Fertilizer and Chemicals Ltd.

As there are no LNG import terminals and no pipeline connectivity on the east coast of India, there is a strong need to develop an LNG import, storage and distribution terminal at Haldia with road evacuation facilities to cater to LNG demand of the hinterland by delivery via road tankers. Considering the attractiveness of the location, huge untapped gas demand of nearby industries and fall in LNG prices, there is a strong case for development of a new LNG import terminal at Haldia. To tap these excellent opportunities, Ultra LNG Haldia Limited (SPV Company) proposes to develop a LNG import, storage, distribution, and bunkering supply terminal in the Industrial Zone of Haldia Dock Complex at Haldia.

The project will primarily include the development of LNG terminals at existing oil jetty (HOJ-1), Outer Terminal 2 (OT-2, which is currently under construction) and barge jetty, loading arms, storage facilities, regasification facilities, evacuation facilities (pipeline and road gantry facilities) and ancillary works.

3.2 TRAFFIC STUDY

3.2.1 Gas Demand in India

Indian economy is expected to continue to be amongst the fastest growing economies of the world. Considering the increasing demand for energy in India and the limited domestic availability of fuel resources, the contribution of imported fuels in the country's energy mix is on the rise. In this backdrop, the Natural Gas usage is bound to increase given the growing affordability and rising demand.

Natural gas is a clean and efficient fuel unlike coal which has lower efficiency and high levels of environment concerns.

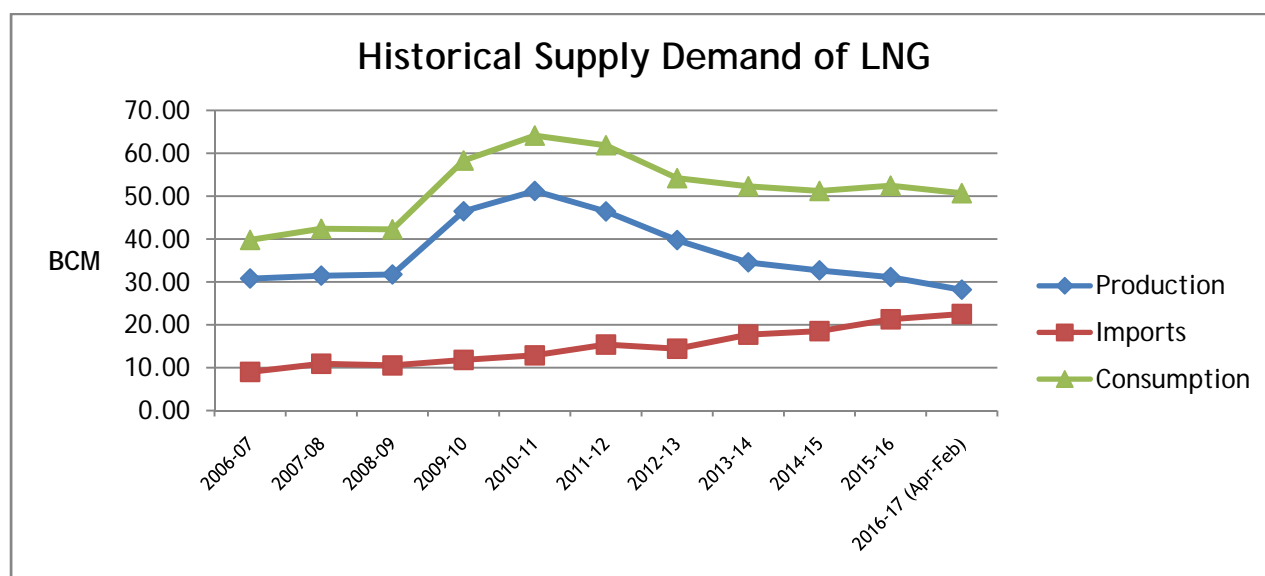
The government of India in its policy document "Hydrocarbon Vision 2025" outlined India's goal to significantly increase gas usage by 2025. This ambition is mainly an effort to wean the overall Indian economy off its dependence on coal and Liquid fuel for environmental reasons.

Currently gas based power generation is around 9% of total power production in India, which is much below world average of 22%.

3.2.1.1 All India Historical Supply and Demand for LNG

(Billion Cum. - BCM)

Year	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (Apr-Feb)
Production	30.79	31.48	31.75	46.49	51.23	46.45	39.75	34.57	32.69	31.14	28.18
Imports	9.03	10.93	10.54	11.82	12.89	15.41	14.44	17.73	18.54	21.31	22.53
Consumption	39.82	42.41	42.29	58.31	64.12	61.87	54.20	52.30	51.23	52.45	50.71



Based on the historical production and consumption data for LNG, the following is observed:

- The domestic production of natural gas has witnessed a sharp decline over the past 5 years decline of approx. 40% at a CAGR (Compound Annual Growth Rate) of -10% between 2011 and 2016. KG D6 had shown some promises in 2009-10 and 2010-11 but later on production started reducing.
- Gas consumption has steadily increased over the past 10 years (3% growth) between 2007 and 2016 spurred by the increased demand for clean fuels in India.
- The large decline in LNG production has resulted in strong need for imports to meet the demand supply gap in India. LNG imports have grown at a CAGR of 11% in the past 5

years between 2011 and 2016 and at a CAGR of 10 % in the past 10 years between 2007 and 2016.

- This high import demand has been achieved in the scenario of high LNG prices in international market. There is a huge latent demand which has not materialized in the past due to high LNG prices.
- Reduction in LNG prices in last one year has improved the prospect of LNG import for industrial use, power generation and city gas distribution.

3.2.1.2 Huge gap between gas consumption and realizable demand

Various studies on gas demand in India have found that there is a huge demand for gas in the country across the sector. Actual gas consumption is much lower than the demand due to lack of infrastructure and fluctuation of gas prices and associated uncertainties.. Comparison of working group of 12th five year plan and actual gas demand is provided below:

Sector	Demand projected by working Group 12th five year plan	Domestic gas consumption in June 2016	Imported LNG consumption in June 2016	Total Gas consumption
	MMSCMD	MMSCMD	MMSCMD	MMSCMD
Fertilizer	113	22	22	44
Power	207	24	6	30
City Gas	46	11	7	18
Industrial	27	1	1	2
Petrochemical/refinery/internal consumption and other miscellaneous	72	10	31	41
Sponge iron/steel	8	0	1	1
Total	473	67	68	135

- Realizable demand for gas in India is 3-4 times the actual consumption of gas.
- Now, imported LNG is almost equal to domestic production.
- With fall in LNG prices, demand for imported LNG will further increase hence there will be high demand for LNG import terminals.

Sectors which lead consumption of LNG include Power, Fertilizers and Industry Sectors:

- **Power:** The supply demand gap is fueled by the fact that gas based power plants are operating much below their capacity. More than 25,000 MW of gas based power plants are installed. Further, cost of power generation through coal is increasing and with the power deficit increasing, natural gas plants will eventually become a competitive and viable option.

- **Fertilizer:** The fertilizer industry in India is increasing substantially which will spur the demand for natural gas.
- **Auto & CGD:** Shift towards LNG operated vehicles, development of City gas distribution networks are other positive factors for LNG imports.

Broadly, the following factors are expected to drive the increased consumption of natural gas in India:

- **Macroeconomic setting and policy making**

Overall macroeconomic conditions in the economy will set the demand for energy and the growth of energy demand. India has been enjoying higher growth rates since the early 1990s because of economic reforms. This growth will contribute to greater demand for energy.

- **Fall in LNG Prices**

The recent crash in prices of crude oil has led to a reduction in price of LNG as LNG prices follow crude prices with a time lag. Decrease in LNG prices has made LNG imports in India a viable option for operation of gas based power plants which are currently idle and is likely to spur growth in gas consumption. New liquefaction capacity is getting commissioned in various parts of the world like Australia, new supply will put further pressure on LNG prices and prices are expected to remain for next few years.

- **Growth of end-user segments**

The robust growth outlook for the Indian economy and the resultant increase in the end-user consumption of the natural gas is expected to drive the natural gas market in the future. Reduction in gas prices has made supply of PNG more viable for domestic consumption in both urban and rural cities. Recent fall in the natural gas prices will also make gas based power plants able to competitively run on imported LNG. These units are currently shutdown or operating at very low Power Load Factors. Gas based iron making steel units will also benefit from the fall in LNG prices.

- **Regulation**

The PNGRB Act, 2006 is an overarching framework that would attract, enable and sustain much needed capital into the entire sector. It will also take the shape of protecting consumer interests and those of industry participants. With regulatory clarity, it is envisaged that gas sector would develop in a big way with a number of cities being connected with gas pipelines and city gas distribution networks supplying natural gas to consumers.

- **Environmental concerns**

With India becoming a signatory to the Kyoto Protocol, there is an emphasis on reduction of greenhouse gas emissions. Gas is preferred as it has lowest carbon emissions for a hydrocarbon per unit of energy generated. The promotion of gas can earn certified emission reduction credits and CDM project developers can gain monetarily from such projects / transactions.

- **New uses of Natural Gas (eg. co-generation)**

Natural gas can be considered as “single fuel solution”, replacing fuel for power for heating and cooling requirements. Use of gas in co-generation of power, refrigeration and heating (CCHP- Combined Cooling, Heating & Power) gives 75% to 90% thermal efficiency. Given the economic advantage in terms of efficiency, industrial and commercial institution are likely to switch to the single fuel application, once natural gas becomes available.

The demand for gas can be categorized as under;

- **Existing gas demand:** The existing gas demand is defined as the present demand for natural gas by the entity based on current supplies from all sources or its gas allocation, whichever is higher.
- **Switching gas demand:** Switching gas demand is defined as the demand resulting from switching of units operating on alternate fuels such as Naphtha/ Fuel Oil/Light Diesel Oil to gas when the same is made available at economical price. This demand is expected to materialize gradually over the forecast period.
- **Gas demand from capacity additions:** This is the gas demand from green field / brown field capacity additions in various sectors and has been estimated on the basis of the demand/ supply outlook for the sector till 2020. This includes demand from capacities that have been announced and are expected to come up to meet the demand / supply gap in the sector.

3.2.1.3 Requirement for Additional Import Terminals in India

Capacity of Existing LNG Terminals in India:

LNG Terminal	Location	Existing Capacity (MMTPA)	Capacity Utilization (%)	FY 16 Traffic (MMTPA)
Petronet LNG Ltd.	Dahej	10(increased to 15 from Aug 2016)	110.0%	11.0
Hazira LNG Pvt. Ltd.	Hazira	5	70.4%	3.5
GAIL	Dabhol	1.69	80.8%	1.4
Petronet LNG Ltd.	Kochi	5	5.6%	0.3
Total		21.69 (increased to 26.69 from Aug 2016)		16.2

The following LNG import terminals are currently present in India :

- Petronet LNG Limited (PLL) commissioned its Dahej terminal in April 2004 and has a total capacity of 10 MTPA (increased to 15 MTPA from August 2016). PLL sells gas to GAIL, IOCL and BPCL that sell to consumers in Gujarat and other Northern States.

- Shell-Total together commissioned the LNG regasification terminal at Hazira and with a total capacity of 5 MTPA. Hazira LNG has entered into contracts with both Gujarat State Petronet Limited & GAIL for transporting gas within Gujarat.
- GAIL Dabhol Terminal has a capacity of ~ 1.7 MTPA (Development in first phase without breakwater) which is expected to expand to 5 MTPA.
- Petronet LNG Limited (PLL) Kochi has a capacity of 5 MTPA. Utilization at this terminal currently is low due to connectivity issues to the hinterland.

As there are no LNG import terminals and no pipeline connectivity for gas distribution in eastern India, there is a strong need to develop an LNG import, storage and distribution terminal at Haldia with road evacuation facilities to cater to LNG demand of the hinterland by delivery via road tankers.

3.2.2 POTENTIAL MARKET FOR LNG AT HALDIA

IMMEDIATE DEMAND POTENTIAL AT HALDIA

- **IOCL refinery at Haldia:** The refinery is fourth in chain of 10 operating refineries of IndianOil. The Haldia refinery is one of the two refineries of IndianOil Group companies producing Lube Oil Base Stocks (LOBS). The refinery was commissioned in January 1975 and has a refining capacity of 7.5 MTPA. It is located close to the proposed location and may use regasified LNG for its power plant and process requirement. Detailed demand assessment of IOCL at various price points of LNG is being estimated.
- **Haldia Petrochemicals:** Haldia Petrochemical Complex is a modern naphtha based Petroleum Complex located at Haldia. The complex has a capacity to process more than 350,000 TPA of polymers. It uses naphtha for the cracking process for production of various feedstock for the petrochemical plant. Company can also use natural gas in the feedstock as a fuel and as a process requirement.
- **Matix Fertilizer and Chemicals Ltd** is building a greenfield fertiliser complex with a capacity to produce 3 MTPA urea at Panagarh near Durgapur, West Bengal. In Phase I, the company has invested Rs. 6000 Crores to set up a single stream 2,200 Metric Tonnes per Day (MTPD) Ammonia plant and 3,850 MTPD Urea plant (1.3 MTPA) along with associated offsite and utility facilities. The plant will use energy efficient and latest technology from industry leaders Kellogg, Brown & Root (KBR), USA and Saipem, Italy. The plant will be one of the world's largest single stream plants and the first with a feedstock supply of coal bed methane (CBM) gas. This will be sourced from the Raniganj block, near Panagarh in West Bengal. The first phase will be operational by first half of 2017 and will require LNG for operations at its full capacity. Estimated quantity of LNG required will be determined based on demand assessment.

- **City Gas Distribution (CGD)** – Greater Calcutta Gas Supply Corporation Limited, (GCGSC) has created an infrastructural facility to distribute 30 MMCFD gas. Due to various bottlenecks, Dakuni Coal Complex (DCC) could not operate their plant at full capacity and could not supply 20 MMCFD gas. At present only about 3 MMCFD coal gas is available from DCC, so there is net demand of 27 MMSCFD of gas which is approximately, 0.75 MMSCMD or 0.2 MTPA.

With import terminal at Haldia and the existing infrastructure facility city gas market for Pressurized Natural Gas (PNG) and Compressed Natural Gas (CNG) can also be targeted. India has overall consumption of approx. 20 MMSCMD of gas through CGD which is growing at a healthy rate of 6-7 percent per annum. West Bengal can easily have market of 2 MMSCMD of CGD in next 3-4 years which translates into approx. 0.55 MTPA of LNG.

Based on demand estimates, proposed facility will be planned for handling 1 MTPA of LNG.

3.3 EMPLOYMENT GENERATION

A large number of people will be employed for road movement of LNG and construction of LNG storage facilities. The Proposed LNG Terminal development will generate employment for ~ 50 people directly and there will be indirect employment generation of ~1,000 people from the project. Further, natural gas, being a cleaner fuel, will replace some of FO, Naphtha and Diesel requirements as a fuel source. Industries dependent on gas will develop in eastern India generating addition employment in the future.

3.4 FUNDS ALLOCATED FOR CSR ACTIVITIES

“Need” based studies will be conducted in consultation with local jurisdictional authorities and funds shall be allocated as per guidelines of the Company Act.

3.5 FUNDS ALLOCATED FOR POLLUTION CONTROL EQUIPMENT

- Funds shall be allocated for Environmental Protections measures of the following items: Gardening/Horticulture
- Rain Water Harvesting
- Septic Tank/Soak Pits
- Gas Monitoring System
- Monitoring of Air and Noise Pollution
- Water Management

3.6 FACILITY DETAILS

Ultra LNG Haldia Limited proposes to develop an LNG import, storage and distribution facility in the Industrial Zone of Haldia Dock Complex at Haldia. At the allotted land, LNG will be stored and transported via road tankers to the end customers. Cryogenic Pipeline will also be developed for transport of LNG to Barge Jetty for bunkering or loading of LNG into small LNG vessels. When the terminal gets connected via gas pipeline, LNG, which will be imported via LNG vessels, will be stored and regasified and then transported to end customer on the pipeline grid.

Project Facilities to be developed will primarily include the following components:

- Existing oil jetty (HOJ-1) and Outer Terminal 2 (OT-2) will be used for berthing of LNG vessels of 10,000 – 50,000 cbm capacity (draft of 7 – 8 m). Currently the HOJ-1 jetty handles LPG and POL products and new oil jetty (OT-2) is under construction; hence equipments for handling of LNG need to be installed such as marine unloading arms, cryogenic pipelines etc. Modification of the jetties may be required for marine fixtures. Additional equipments and safety features will be installed on the jetty for handling LNG based on risk assessment
- Marine Unloading Arms (1 Vapor(if required), 1 Liquid, 1 dual purpose) at each Jetty. Marine Unloading Arms will be designed based on LNG vessel capacities and estimated vapor generation during the unloading operation. One liquid arm and one vapor arm (if required) will be used while one dual purpose unloading arm will be kept as spare. Requirement of use vapor arm will be determined based on detailed engineering. Cryogenic pipeline will be developed for transfer of LNG from jetties to storage facilities.

Initial plan is to develop storage facilities of ~40,000 cbm at the allotted land. Same may be modified based on demand assessment and utilization of the terminal and compliance of various safety and regulatory requirements for LNG storage. Storage facilities will be in form of atmospheric tanks, pressurized bullets or iso-containers. The storage tanks will be designed to store LNG at cryogenic conditions of ~ -162 °C.

- LNG vapor condensation system if required will be decided based on detailed engineering
- Cryogenic Pipelines connecting unloading arms at the jetties to Storage facilities/Regasification unit.
- 3 Road Gantries of 8 bayseach (total of 24 bays)is planned which will be developed in phases based on demand. If initial expected demand is low, only 4 bays will be developed initially and as demand increase more bays will be added to the terminal.

- Bunkering/LNG loading facilities may also be developed at the barge jetty which is ~ 750 m away from HOJ 1. Pipeline connectivity from the storage facilities at the allotted land to the barge jetty will be developed to facilitate loading of LNG into barges or for bunkering purposes.
- Once pipeline connectivity has been developed, regasification units with requisite capacity will be installed based on demand estimates, connectivity of the terminal with gas pipeline and utilization of the terminal. LNG will be vaporized by using a primary heating medium (ambient air or water) at the regasification units and will be transported through gas pipeline from the Regasification Unit to the end customer connected on the pipeline grid.
- Emergency response systems, fire protection systems, provision of utilities (e.g. Nitrogen, fire water, Instrument Air etc.)

3.7 PROCESS FLOW

LNG will be imported via LNG vessels and will be stored, and distributed to the customers through road tankers as well as loaded into barges at the barge jetty. In future if terminal gets connected with gas pipeline, then regasification facilities will also be developed and regasified LNG will be transported through pipelines.

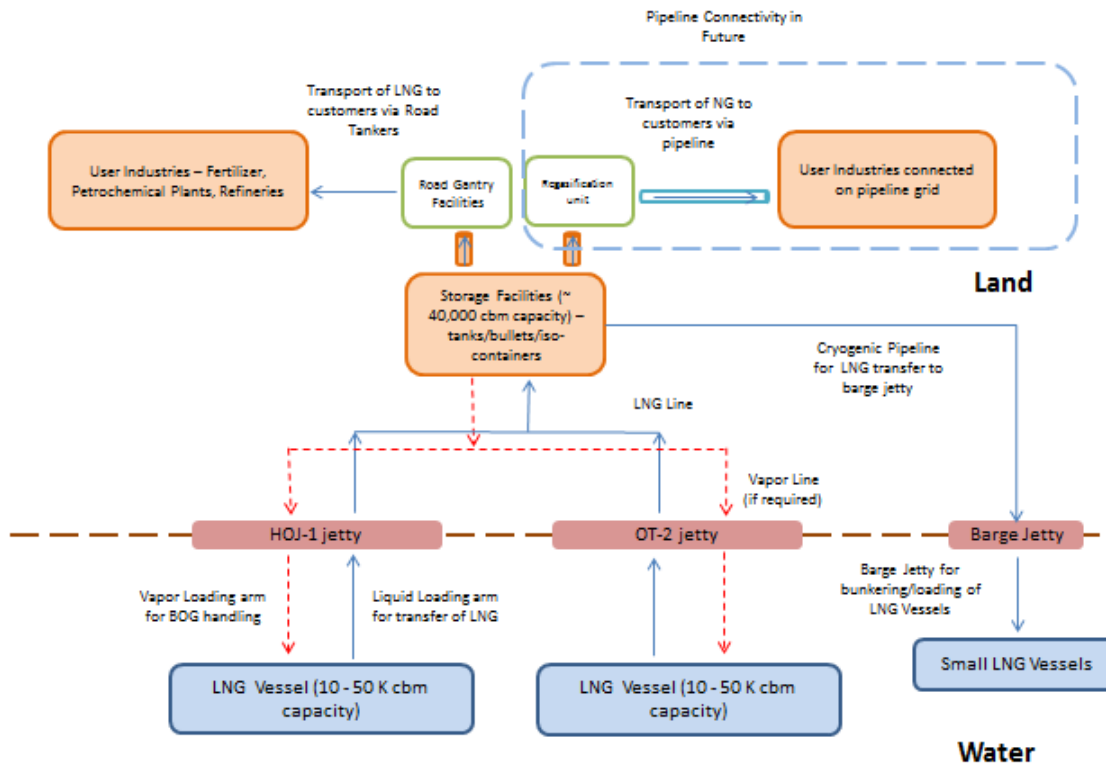


Figure 1: Delivery of LNG/NG to customers

3.7.1 RECEPTION OF LNG FROM LNG VESSELS

Due to draft restrictions of 7-8 m at Haldia, LNG will be received at HOJ-1 and the Outer Terminal 2 (OT-2, currently under construction) via LNG vessels (of 10,000 – 50,000 cbm capacity).

Currently the HOJ-1 jetty handles LPG and POL products; hence equipments for handling of LNG need to be installed like marine unloading arms, cryogenic pipelines etc. Modification of the jetty may be required for marine fixtures. Additional equipments and safety features will be installed on the jetty for handling LNG based on risk assessment

3.7.2 STORAGE OF LNG AT JETTY/LAND NEAR JETTY

LNG will be transported from the vessels via Marine Unloading Arms and cryogenic pipeline to Storage facilities on the allotted land.

Marine unloading arms (1 Vapor (if required), 1 Liquid and 1 dual purpose arm) will be installed at each jetty (HOJ-1 and OT-2). The HOJ-1 jetty is in possession of Haldia port and is utilized to handle other cargo such as POL products.

Marine Unloading Arms will be designed based on LNG vessel capacities and estimated vapor generation during the unloading operation. One liquid and one vapor arm will be used while one dual purpose unloading arm will be kept as spare. Requirement of vapor loading arm will be determined based on detailed engineering.

Storage facilities of ~ 40,000 cbm capacity will be developed at the allotted land. LNG will be stored at cryogenic conditions of ~-162 °C. Storage facilities to be developed will be a combination of the following storage types:

A. PRESSURIZED BULLETS/PRESSURIZED BULLET TANKS

This class of tanks offers the possibility to hold pressure during a given time, therefore relieving the need to manage the LNG boil off gas like in any conventional terminal. Basically if the LNG is delivered cold, a storage tank of this type can contain BOG for one or two weeks before the next delivery that will help to recondense the BOG in the receiving tank (LNG used to refill is pumped and therefore slightly subcooled which helps to recondense). Pressurized tanks currently have a maximal size of 1,200m³.

B. ATMOSPHERIC TANKS

Tanks can be of different integrity levels:

- Double Containment (DC), double integrity level
- Full Containment (FC), full integrity level

In a DC tank, the outer wall is noncryogenic steel but there is a storage pit or wall that can contain the LNG if a spill occurs on a rare occasion. In a FC tank, the outer wall is from cryogenic steel and if the inner wall leaks, the vapors are contained.

C. ISO-CONTAINERS

Iso Containers (each having a storage capacity of 17.5 MT each) have an inner vessel, outer vessel and multilayer insulation for storage of LNG. They are IM07 fully certified tank containers (UN Portable 75) and possess approvals and certifications such as ASME SEC VIII, DIV-1, US DOT 49 CFR 178.274 & 277 (UN Tank), CGA341. Container size varies from 20 to 40 feet with hold times between 95-131 days.



Figure: Example of Iso-container for storage of LNG

3.7.3 DISPATCH OF LNG VIA ROAD GANTRY FACILITIES

3 Road Gantry facilities of 8 bays each (total of 24 bays) are planned which will be developed in phases based on demand. If initial expected demand is low, only 4 bays will be developed initially and as demand increases more bays will be added to the terminal. For better utilization of terminal and to avoid congestion of truck parking area, it is proposed to have full day operation for the road gantry and required safety guidelines will be followed for night loading operation subject to getting required approvals from concerned authorities.

Road Gantry equipment will load LNG into iso-containers (~ 17.5 MT each) or tank trailers which will be transported to the end customer. Haldia is connected to the industrial hinterland of Central and Eastern India via well developed 4 lane roads and National Highways. Various small scale customers can be serviced through road and it is more effective to cater to the need of small customers. Gas pipeline connectivity is not there at present and even after gas pipeline connectivity, small customers may prefer servicing through road for better flexibility.

3.7.4 REGASIFICATION AND DISPATCH OF NATURAL GAS VIA PIPELINE

Once gas pipeline for evacuation is developed, LNG will be regasified at regasification unit at the terminal and regasified LNG will be transported through gas pipelines. Regasification unit may use ambient air or water as the primary heating medium of LNG. Water will be provided by the Haldia Dock Complex.

3.7.5 TRANSPORT AND EVACUATION OF LNG AT BARGE JETTY

LNG may be loaded into small LNG vessels or into the barges using LNG as bunker fuel at the barge jetty which is ~ 750 m away from HOJ 1. Pipeline connectivity of requisite distance will be developed between the storage facilities and the barge jetty for transport of LNG to be loaded or used as bunker fuel on small LNG vessels. LNG stored in the tanks will be transported via cryogenic pipeline to the barge jetty which will be loaded into small vessels.

Loading arm facilities and marine fixtures will also be developed to facilitate loading of LNG into the vessels.

3.7.5.1 FUNCTIONAL PLANNING

Ship Size

Due to draft restrictions at Haldia port, LNG Vessels of 10,000 – 50,000 cbm capacity (~ draft of 7-8 m) will be used for import of LNG at Haldia jetties.

Capacity of System

Once pipeline infrastructure for evacuation of LNG is developed, to deliver ~ 1 MTPA of NG to end customers in the hinterland of Haldia Port, regasification unit with regasification capacity of 250 MMSCFD will be developed.

3.8 PROPOSED LAYOUT

The proposed layouts for development of the LNG terminal considering the following options of storage:

- Pressurized Bullets/Pressurized Bullet Tanks
- Iso-Containers
- Storage Tanks

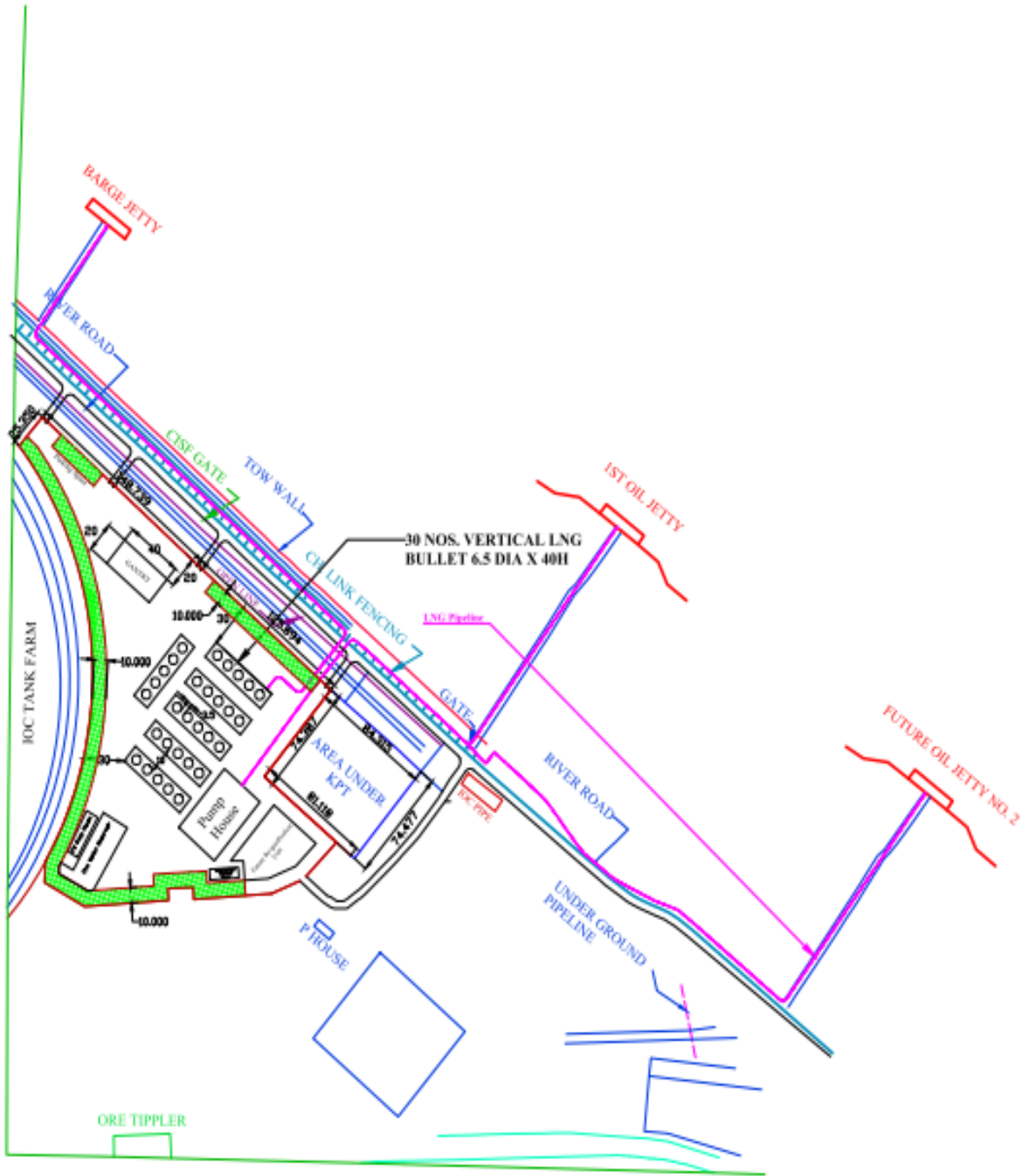


Figure: LNG Storage in Pressurized Bullets

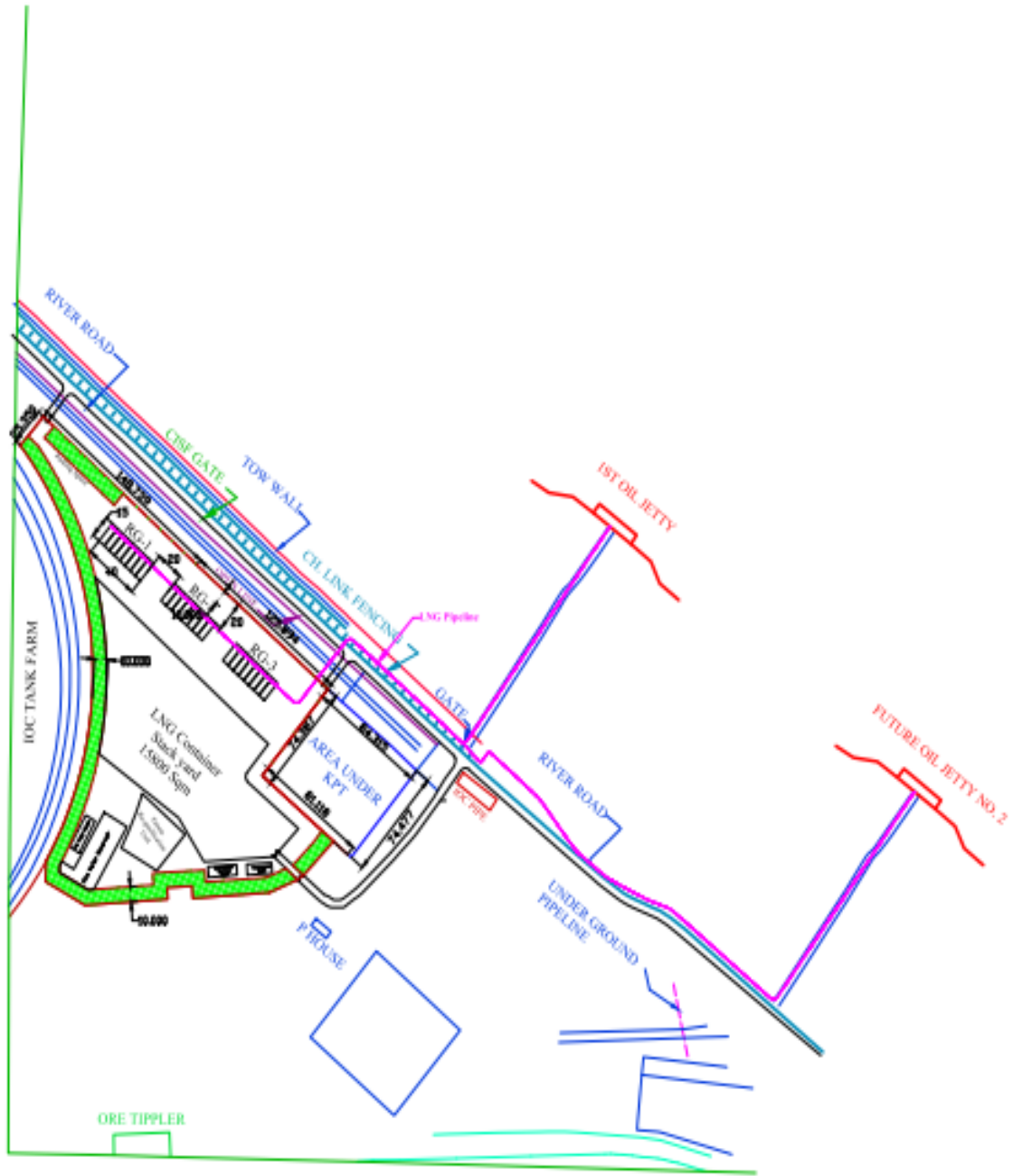


Figure: LNG Storage in Iso-containers

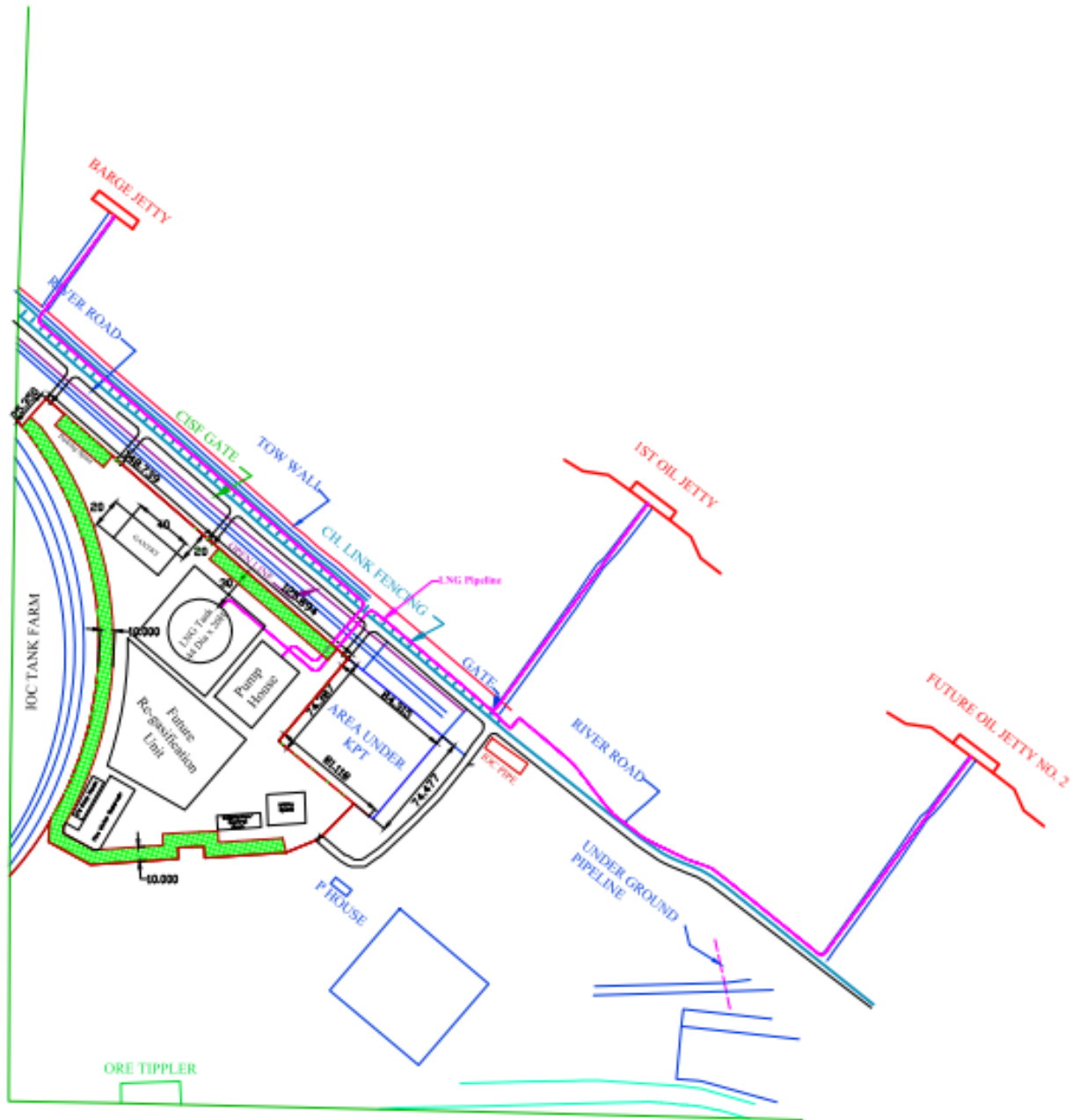


Figure: LNG Storage in Storage Tanks

3.9 DREDGING

For development of LNG terminal at Haldia, it is envisaged that no dredging would be required.

3.10 HEALTH, SAFETY AND ENVIRONMENTAL (HSE) SYSTEM

Studies such as Risk Assessment, etc. will be undertaken to identify and reduce all HSE risks. It is also important to integrate all the elements (health, safety, security, environment and social performance) of HSE risks as early as possible. All the decisions in the conceptualization stage and during design stage will balance and reduce overall risk. This ensures that the residual risk is handed over to the operation group as low as reasonably practicable (ALARP) and will continue to be managed as part of the Operations Phase of the project.

The guiding principle is that the best HSE outcomes result from the identification and management of critical HSE issues as early as possible in the project development. For many activities, high-level screening activities or coarse studies are specified in early project stages followed by detailed studies as more data become available.

3.11 HSE MANAGEMENT IN OPERATIONS

An HSE Management System will be established as the framework for systematically managing all HSE risks; it will define the organisation structure, responsibilities, practices, procedures and resources for managing business and marine activities. It will be the responsibility of senior operations staff to provide leadership and so ensure that an HSE culture is embedded within the entire workforce and that everyone involved in the facilities fully understands, participates in and is committed to HSE.

Existing operations will also comply with ISPS standards. A Port Facility Security Officer (PFSO) included in terminal organization will be trained and certified.

Key staff will ensure that process and personal HSE considerations are fully understood and evaluated throughout the lifecycle, from the concept stage, through project execution, start-up and operations and finally to decommissioning. Performance targets will be set and indicators will be established to determine how well the operation is performing in key areas.

An HSE case or safety case will be prepared, which gives an overview of the potential hazards affecting the project, focuses on the major HSE issues as the design develops, records how these have been controlled or mitigated and, ultimately, provides assurance to regulators and other interested parties of the safety of the facility. It will eventually be developed to become the operational safety case prior to start-up in accordance with regulatory requirements. QRAs, HAZIDs and HAZOPs are supporting elements of the HSE case.

An Emergency Response (ER) plan will develop contingency plans that focus on the management of all the potential incidents during all phases of the life cycle of the integrated production system.

4 SITE ANALYSIS

4.1 PORT LOCATION

Haldia Port is located in West Bengal on the east coast of India. Approximately 140kilometers southwest of Kolkata, it is situated at a latitude of 22° 02´ North, Longitude : 88° 06´ East

The Project is located at Haldia in West Bengal. Approximate location details of the land site and 2 jetties (HOJ-1 and OT-2) are as follows:

Land Site

Latitude – 22° 2'0.02"N

Longitude - 88° 5'55.22"E

HOJ-1

Latitude – 22° 01'50.22" N

Longitude - 88°05'58.68" E

OT-2

Latitude - 22° 01'34.65" N

Longitude - 88°05'32.40" E



4.2 CONNECTIVITY

Haldia is an all weather port and has excellent connectivity to National Highways, Railways and acts as a gateway to Eastern and north eastern parts of India.

The port of Haldia acts as the guiding factor to trade and commerce of vast hinterland comprising the entire Eastern India including Bihar and Eastern Uttar Pradesh and Nepal and Bhutan

Pipeline Connectivity

GAIL has been awarded a contract for construction of gas pipeline from Jagdishpur to Haldia. Once the pipeline gets constructed, it will connect Haldia to the market of East and North India.

Rail Connectivity

Haldia is directly connected to the Indian Railway System by Broad Gauge. The nearest Railway Station is Haldia at around 7 Km in the NW.

Inland Waterways

Haldia is located on the National Waterway No. 1

Road Connectivity

Customers can be served through road tankers. IOCL refinery is within 20 km and **Matix Fertilizer and Chemicals Ltd** is at approx. 250 km away from the port. City of Kolkata is approx. 130 km away from the port. Hence all the demand centres are well within the catchment area for the road tankers.

Haldia is connected through NH 41, which is connected to NH 6. Both NH 41 and NH6 are in the process of being widened.

NH 41 connects the port city with NH 6 (part of Golden Quadrilateral) at Kolaghat. From Kolaghat NH-6 connects Orissa, Jharkhand, Kharagpur, Bankura and Purulia and also Durgapur, through NH-34 to North Bengal, Bangladesh via Petrapole and Bhojadanga Land Custom Stations. A State Highway also connects Haldia with Kolaghat via Tamluk town which is the district headquarters as an alternate connectivity.

4.3 SOIL CLASSIFICATION

The Soil classification at the Haldia Port is generally Alluvial, black, reger and red terrogeinous.

4.4 CLIMATE

4.4.1 Relative Humidity

Relative Humidity: ~ Avg. of 45%

4.4.2 Temperature

Haldia has a typical moderate climate with winter temperatures ranging from 7-22 °C. Summers can be hot and humid. Usual summer temperatures in May, the hottest month range from 24 – 39 °C

4.4.3 Wind

Mean Speed: ranges from 5.5 to 9.9 kmph

4.4.4 Cyclones

Port falls under high risk zone for wind and cyclones

4.4.5 Seismic Zone

Port falls under the seismic Zone IV - High Damage Risk Zone.

4.5 SOCIAL INFRASTRUCTURE

Facilities available at port include Schools, Colleges, Hospitals, Transportation services, etc.

5 STUDIES AND INVESTIGATION

Risk Assessment studies will be conducted to comply with safety and regulatory requirements to handle LNG.

6 REHABILITATION AND RESETTLEMENTS (R& R) PLAN

There is no Rehabilitation and Resettlement (R&R) involved in the project.

7 PLANNING BRIEF

7.1 ONSHORE CIVIL AND STRUCTURAL WORKS

7.1.1 Introduction

Following covers the minimum requirements for the design of steel structures, foundations, equipment foundations (if any), RCC framed buildings, Masonry structures, masonry walls, foundations for Pipe Racks, flooring, pavements, roads, drainage, cross drainage structures like culverts, small bridges, sewerage systems etc.

7.1.2 Scope of Major Civil & Structural Works

The scope of major Civil & Structural Works includes but not limited to the following;

- Pipe & Cable Racks
- Substation Building along with Control Room
- Foundation Engineering for Technological Structures
- Pumps and Tank Foundations
- Route Survey and Alignment Drawings for Pipelines
- Back up Power
- Fire Fighting System
- Interfacing with existing facilities
- Road & Drains

7.1.3 Codes and Standards

The work associated with this specification shall comply with the relevant requirements of the current issues of the following standards, codes and supplementary specifications.

- IS 875 : (Part1-3) – Code of Practice for Design Loads for buildings & structures
- IS 1893 : (Part1-2) – Criteria for Earthquake resistant design of structures
- IS 456 – Plain and Reinforced Concrete - Code of Practice
- IS 13920 – Ductile Detailing of reinforced Concrete Structures subjected to Seismic Forces – Code of Practice
- IS 3370 – Code of Practice for concrete structures for storage of liquids
- IS 800:1984 – General Construction in Steel – Code of Practice
- IRC : 5&6 – Code of Practice for Roads and Bridges
- IRC : 58 – Guidelines for the design of rigid pavements
- IS 8835 – Guidelines for design of surface drains
- IS 1080 – Code of practice for design & construction of shallow foundations in soil
- IS 1904 – Code of Practice for design and construction of foundations in soil general requirements
- IS 2911 – Code of Practice for design and construction of Pile Foundation

7.2 RESOURCE UTILIZATION

- **Water for plant:** For operation of the facility approximately 15 m³ per day of freshwater is required for Domestic/Fire system. Water will be provided by Haldia Dock Complex. Approximate Manpower of 50 persons (50 liters per day, lpd), 160 trucks (320 drivers and cleaners @ 15 lpd) are envisaged per day. Additional water shall be required as make-up water during monthly mock drills.
- **Power:** Power required for offshore and onshore facilities including area lighting at jetty will be provided by Haldia Dock Complex
- **Construction materials:** Construction material such as steel, cement, aggregates, steel sheet piles, armour rock

7.3 UTILITIES

The key utility systems include the following:

Firewater system: firewater system to comply with both marine and offshore safety practices

Firefighting system: to include electrical based as well as diesel engine based firefighting system

Standby Power and distribution system: for backup power distribution

Compressed air systems: for the supply of compressed air such as Plant air, compressed undried air, compressed dry air, air driven tools, instrument air,

Miscellaneous instrumentation and automation systems

7.4 Waste Management

7.4.1 Liquid and solid waste

LNG terminal facility will generate the following:

- Office waste like paper etc. is expected
- Packing material will be sold to pollution control board vendors

Hazardous waste if any,

- Discarded lubricating oil container shall be sent to authorized recycler.

7.4.2 Effluents

Domestic sewage to be disposed via septic tank and soak pit.

7.4.3 Air Emissions

LNG is a clean fuel and no combustion of fuel is planned. It's only a phase transfer of LNG. There might be possibilities for generation of NO_x emissions while power generation with

Blow off gas at LNG vessel and Flue gases generation from Diesel operated Fire pumps. A suitable flare stack will be provided if needed. Further Fire Engine Stack and DG stacks will also be provided as required.

7.5 Greenbelt

Greenbelt will be developed in the peripheral of the land site around the storage facilities and other areas. Development plan will be finalized based on CCoE approval/ and considering the safety aspects & PESO regulations.

8 PROJECT SCHEDULE & COST ESTIMATE

8.1 IMPLEMENTATION SCHEDULE

The Project shall be implemented within shortest possible time once all the permission and clearance from State and Central statutory bodies are obtained. It is estimated that since the start of the construction work it will take 16 months to commission the Terminal.

8.2 COST ESTIMATES

Project cost is estimated to be ~ Rs. 450 Crores which shall comprise of the following components:

1. LNG Road Terminal – Investment required to develop road gantry facilities for distribution of LNG via Road Tankers to customer location.
2. Unloading Arms, Pipeline – Procurement of unloading arms, cryogenic pipelines, gas pipelines
3. LNG Storage facilities – for storage of LNG with a total capacity of ~ 40,000 cum to be developed
4. Firefighting System – firefighting system will be developed near the jetty.
5. Preoperative expenses – will include upfront finance cost to be provided
6. IDC – Interest During Construction of the terminal
7. Contingency